STRUCTURED ANALYSIS/DESIGN

LSA TASK 303

EVALUATION OF ALTERNATIVES AND TRADE-OFF ANALYSIS

SUBTASK 303.2.3
SYSTEM TRADE-OFFS

966-244

APJ

MILITARY & SCIENTIFIC RESEARCH

AMERICAN POWER JET CO. RIDGEFIELD N.J.

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This report consolidates the Structured Analysis and Structured Design for the Logistic Support Analysis (LSA) Tasks. Included are the Data Flow Diagrams (DFDs) for LSA Subtask 303.2.3, "System Trade-Offs", and the corresponding descriptions of the processes, data flows, data stores, and external entities identified on each DFD. The DFDs are further developed into procedures which identifies how to use the data to carry out the processes and accomplish the LSA Subtask. Venture Evaluation Review Technique (VERT) Batch Input files are also provided to assist as tools, giving both technical and managerial aspects of a task.

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APJ 966-244

STRUCTURED ANALYSIS AND DESIGN

LSA TASK 303
EVALUATION OF ALTERNATIVES AND TRADE-OFF ANALYSIS

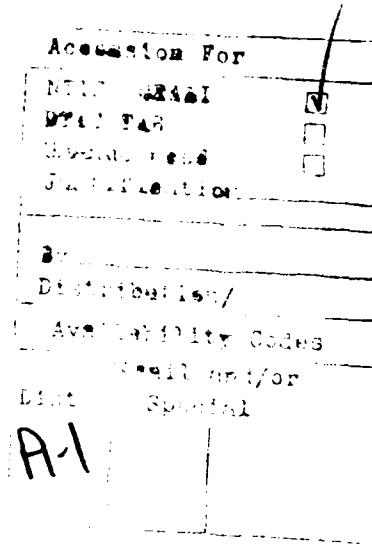
LSA TASK 303.2.3
SYSTEM TRADE-OFFS

under

CONTRACT NO. DAAA21-86-D-0025

for

HQ US AMCCOM
INTEGRATED LOGISTIC SUPPORT OFFICE
AMSMC-LSP
ROCK ISLAND, IL



by

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ST. LOUIS, MO

April 1990

FOREWORD

APJ, under contract to HQs, AMCCOM, has initiated the automation of the LSA Tasks (MIL-STD-1388-1) and the assessment of the ILS elements (AR 700-127). A major goal is to unify military and contractor approach to the performance of ILS and LSA.

Detailed to meet all requirements of ILS and LSA, the automated process will continue to provide the flexibility in selecting tasks and elements to be addressed at each life cycle stage. A major advantage of this approach is to insure that the application of each task element is consistent with prescribed Army policies and procedures.

This report consolidates the Structured Analysis and Structured Design under one cover for the respective LSA Task. Structured Analysis provides a logical model of the method to perform an LSA Task. This logical model facilitates the development of a Structured Design that provides the detailed procedures to perform the analysis. Both the logical model and detailed procedures are used to develop the application software programs which will be provided to Government and contractor personnel to assist in the performance of the LSA Task.

Included in this report are the Data Flow Diagrams (DFDs) for LSA Subtask 303.2.3, "System Trade-Offs" and the corresponding descriptions of the processes, data flows, data stores, and external entities identified on each DFD (Annex B). In addition the DFDs are further developed into step by step procedures (Annex C) which identifies how to use the data to carry out the processes which ultimately leads to accomplishing the LSA Subtask.

To assist managers in planning and controlling this task, Venture Evaluation Review Technique (VERT) Batch Input files are provided (Annex D). These VERT tools provide government agencies with complete packages to give contractors that cover both technical and managerial aspects of a task. This approach establishes a standardized form of communication and management between contractors performing the task and government personnel reviewing the task.

To view this work in context, this report also presents a brief overview of Structured Analysis and its place in the overall systems development process. Additionally, Annex E provides a brief working description of Structured Systems Analysis fundamentals. The overview and certain portions of the introductory text are repeated verbatim in every report in this series so that each report is free standing.

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INTRODUCTION

PURPOSE

The purpose of this report series is to present the results of the APJ Structured Analysis/Design under Contract DAAA21-86-D-0025 for coordination with the AMCCOM Program Manager prior to in-depth programming of ILS and LSA functions and processes. LSA Task 303, "Evaluation of Alternatives & Trade-Off Analysis" (LSA Subtask "Trade-Off Analysis") is addressed in this report.

BACKGROUND

The Department of the Army has a requirement for management control over contractor and Government agency response to the requirements of AR 700-127, "Integrated Logistic Support", and MIL-STD-1388-1, "Logistic Support Analysis". HQs AMCCOM has initiated action to structure each of the LSA tasks, the assessment of each ILS element, the form of the results, and the detailed processes to insure consistency with current Army policies, procedures, and techniques.

This approach (undertaken by AMCCOM and APJ) will insure uniformity in efforts and products, reproducibility of analyses, and a well-defined structure which can be coordinated among all participants in the logistic process to arrive at common understanding and procedures.

SCOPE

This report summarizes the results of the Structured Analysis of the identification of LSA Task 303, "Evaluation of Alternatives & Trade-Off Analysis, LSA Subtask 303.2.3, "Trade-Off Analysis", and presents the associated Data Flow Diagrams (DFDs) developed from the Structured Analysis and the corresponding procedures developed in the Structured Design. The portions of the Data Dictionary relating to the DFDs for this LSA Subtask includes the labels, names, descriptions, processes, data flows, data stores, and external entities. (The Data Dictionary is a "living document" that evolves through the analysis and design process).

The Data Dictionaries developed for each of the individual LSA Subtasks are integrated together into a Master Data Dictionary. Integration of the individual Data Dictionary involves the combination of similar Data Flows, Data Stores, and External Entities. The resulting Master Data Dictionary may well contain some minor differences from the definitions that appear in this report. All processes, and of course, the content of the structured design will remain identical.

The Structured Design portion of this report develops the processes and data flows developed in the DFDs into procedures which are used to accomplish the LSA Tasks. The DFDs provide the method and the Design implements it, by formulating a guide for programmers to write software applications.

This report presents a brief overview of Structured Analysis and its place in the overall systems design process to assist the reader who may not be fully briefed on the symbols and conventions used. It is supported by Annex E, which defines each element in Structured Analysis.

LSA SUBTASK 303.2.3 - DESCRIPTION

LSA Subtask 303.2.3 concerns the development of trade-offs, either internal, external, or internal/external for a specific system and all of its major assemblies, subassemblies, parts, and supporting equipment. Trade-off analysis concerns the determination of optimum trade-offs between performance, design, operations, and logistic support concepts with part of the trade-off analysis covering cost-effectiveness analysis. Such analysis is needed to provide the optimum mix between design, mission performance, logistic support and dollars expended.

Trade-off studies between support systems and equipment alternatives are not part of this LSA task. Such tasks are covered by LSA Task 303.2.2, "Support System Trade-Offs". Design alternatives determined by trade-off analyses which reduce or simplify functions requiring logistic support resources shall be analyzed.

Task output comprises the preferred support system alternatives and the determination of the best approach (support, design, and operation) which satisfies the need with the best balance/trade-off between cost, schedule, performance, readiness, supportability and mission effectiveness.

The LSA Task Description with associated task inputs and outputs is extracted from MIL-STD-1388-1A and is included as Annex A.

APPROACH

The APJ approach to Structured Analysis and Structured Design of an LSA Subtask is:

1. Scope the Subtask defined in MIL-STD-1388-1A with the overall task and determine its relationship with other LSA Tasks.

2. Review all pertinent documentation (e.g., AR's, MIL-STDs, etc.) applicable to the specific topic.

3. Prepare the Top Level DFDs in context of the Subtask, and develop lower level DFDs to further quantity any complex process identified in the top level DFD.

4. Complete the Data Dictionary portion of the Analysis by describing all processes, data flows, data stores and external entities.

5. Apply staff experience in logistic support analysis to assure that the topic has been exhaustively addressed.

6. From the completed DFDs prepare the step by step procedures that form the structured design.

7. Review Data Item Description and other applicable material to develop output reports.

8. If required revise DFDs and Data Dictionary based on preparation of detailed procedures.

9. Validate results in discussions with Army activities and personnel directly involved in the applicable or related LSA tasks.

NOTE: Structured Analysis and preparation of Data Flow Diagrams (DFDs) was further assisted by the application of Structured Analysis software. Licensed by Index Technology Corporation, Excelerator provides for automated tracking of names, labels, descriptions, multiple levels of detail in the data flow diagrams, and industry standards in symbols and diagramming practices.

LSA SUBTASK 303.2.3 - TRADE-OFF ANALYSIS

The Data Flow Diagram is a tool that shows the flow of data, (i.e., data flows from sources) and is processed by activities to produce intermediate or final products.

The DFD provides a useful and meaningful partitioning of a system from the viewpoint of identification and separation of all functions, actions, or processes so that each can be introduced, changed, added, or deleted with minimal disruption of the overall program, i.e., it emphasizes the underlying concept of modularity and identifiable transformations of data into actionable products.

A series of five (5) DFDs have been developed to structure the LSA subtask relative to operations and other support functions:

1.	303.2.3	System Trade-Off Analysis
2.	303.2.3.1A	Consolidate Data for Trade-Off Analysis
3.	303.2.3.2A	Establish and Define Attributes
4.	303.2.3.4A	Identify Cost Formula
5.	303.2.3.6A	Conduct Trade-off Analysis

Each DFD is keyed to the specific task through the identification number assigned in the lower right hand box. The Alpha codes indicate the level of indenture or explosion below the top level, i.e.,:

Top Level.....LSA DFD 303.2.3
First Indenture.....LSA DFD 303.2.3.1A

Each DFD makes reference to the basic LSA task it addresses, as well as the level of indenture (explosion) of the DFD. For example, the first or top level DFD, "303.2.3", refers to the section in MIL-STD-1388-1A which describes the review items. One of the processes (bubbles) on the top level diagram (303.2.3.1) is expanded and identified as "303.2.3.1A", a second level of "303.2.3.1" (Alpha "A" indicates the second level).

Four standard symbols are used in the drawing of a DFD (see Annex E - Figure 1).

A copy of each DFD is presented in Annex B, accompanied by the Data Dictionary process elements. Each entry made in the DFDs has a corresponding entry in the Data Dictionary.

This presents only those Data Dictionary entries necessary for the coordination of the overall concept and details of the processes. To facilitate review of the diagrams, data flow identifications, process, an data store descriptions are provided. As noted above, they will continue to evolve and be expanded in the System Design phase.

VERT DIAGRAMS

The Venture Evaluation Review Technique (VERT) was developed as a network analysis technique to facilitate management decision making. It allows systematic planning and control of programs and enables managers to find solutions to real life managerial problems. The VERT Diagrams and Input Files for this task can be found in Annex D. In order to understand how these Input Files were developed, a brief discussion of the methodology used is provided. The same explanation is repeated verbatim in every report.

ANNEX A
LSA TASK 303

EVALUATION OF ALTERNATIVES & TRADE-OFF ANALYSIS

ANNEX A
LSA TASK 303
EVALUATION OF ALTERNATIVES & TRADE-OFF ANALYSIS 1/

303.1 PURPOSE: To determine the preferred support system alternative(s) for each system/equipment alternative and to participate in alternative system trade-offs to determine the best approach (support, design, and operation) which satisfies the need with the best balance between cost, schedule, performance, readiness and supportability.

303.2.3 TASK DESCRIPTION: Conduct evaluations and trade-offs between design, operations, and support concepts under consideration.

1/ Abstracted verbatim from MIL-STD-1388-1A, April 11, 1983, Page 45.

ANNEX B

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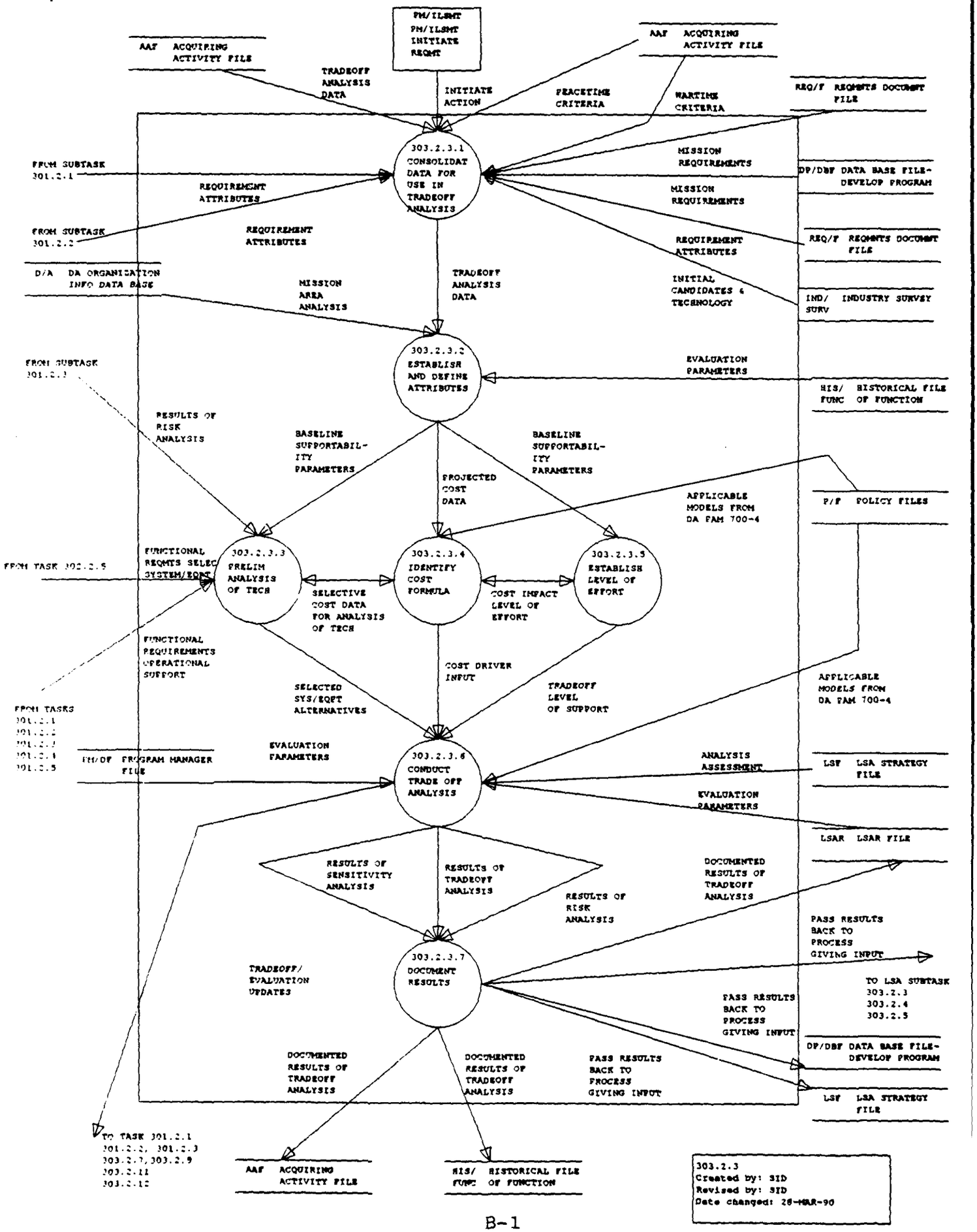
SUBTASK 303.2.3
SYSTEM TRADE-OFFS
DATA FLOW DIAGRAMS AND PROCESS DATA DICTIONARY


PM/ILSMT
PM/ILSMT INITIATE REQMT
AAF ACQUIRING ACTIVITY FILE
AAF ACQUIRING ACTIVITY FILE
TRADEOFF ANALYSIS DATA
INITIATE ACTION
PEACETIME CRITERIA
WARTIME CRITERIA
REQ/F REQMTS DOCUMENT FILE
303.2.3.1 CONSOLIDAT DATA FOR USE IN TRADEOFF ANALYSIS
FROM SUBTASK 301.2.1
REQUIREMENT ATTRIBUTES
FROM SUBTASK 301.2.2
REQUIREMENT ATTRIBUTES
MISSION REQUIREMENTS
DP/DBF DATA BASE FILE-DEVELOP PROGRAM
MISSION REQUIREMENTS
REQUIREMENT ATTRIBUTES
REQ/F REQMTS DOCUMENT FILE
D/A DA ORGANIZATION INFO DATA BASE
MISSION AREA ANALYSIS
TRADEOFF ANALYSIS DATA
INITIAL CANDIDATES & TECHNOLOGY
IND/ INDUSTRY SURVEY SURV
303.2.3.2 ESTABLISH AND DEFINE ATTRIBUTES
FROM SUBTASK 301.2.3
EVALUATION PARAMETERS
HIS/ HISTORICAL FILE FUNC OF FUNCTION
RESULTS OF RISK ANALYSIS
BASELINE SUPPORTABILITY PARAMETERS
BASELINE SUPPORTABILITY PARAMETERS
PROJECTED COST DATA
APPLICABLE MODELS FROM DA PAM 700-4
P/F POLICY FILES
FROM TASK 302.2.5
FUNCTIONAL REQMTS SELEC SYSTEM/EQPT
303.2.3.3 PRELIM ANALYSIS OF TECH
303.2.3.4 IDENTIFY COST FORMULA
303.2.3.5 ESTABLISH LEVEL OF EFFORT
SELECTIVE COST DATA FOR ANALYSIS OF TECH
COST IMPACT LEVEL OF EFFORT
FUNCTIONAL REQUIREMENTS OPERATIONAL SUPPORT
COST DRIVER INPUT
SELECTED SYS/EQPT ALTERNATIVES
TRADEOFF LEVEL OF SUPPORT
APPLICABLE MODELS FROM DA PAM 700-4
FROM TASKS 301.2.1 301.2.2 301.2.3 301.2.4 301.2.5
FM/OF PROGRAM MANAGER FILE
EVALUATION PARAMETERS
303.2.3.6 CONDUCT TRADE OFF ANALYSIS
ANALYSIS ASSESSMENT
LSF LSA STRATEGY FILE
EVALUATION PARAMETERS
LSAR LSAR FILE
RESULTS OF SENSITIVITY ANALYSIS
RESULTS OF TRADEOFF ANALYSIS
RESULTS OF RISK ANALYSIS
DOCUMENTED RESULTS OF TRADEOFF ANALYSIS
PASS RESULTS BACK TO PROCESS GIVING INPUT
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TO LSA SUBTASK 303.2.3 303.2.4 303.2.5
PASS RESULTS BACK TO PROCESS GIVING INPUT
DP/DBF DATA BASE FILE-DEVELOP PROGRAM
DOCUMENTED RESULTS OF TRADEOFF ANALYSIS
DOCUMENTED RESULTS OF TRADEOFF ANALYSIS
PASS RESULTS BACK TO PROCESS GIVING INPUT
LSF LSA STRATEGY FILE
TO TASK 301.2.1 301.2.2, 301.2.3 303.2.7, 303.2.9 303.2.11 303.2.12
AAF ACQUIRING ACTIVITY FILE
HIS/ HISTORICAL FILE FUNC OF FUNCTION
303.2.3
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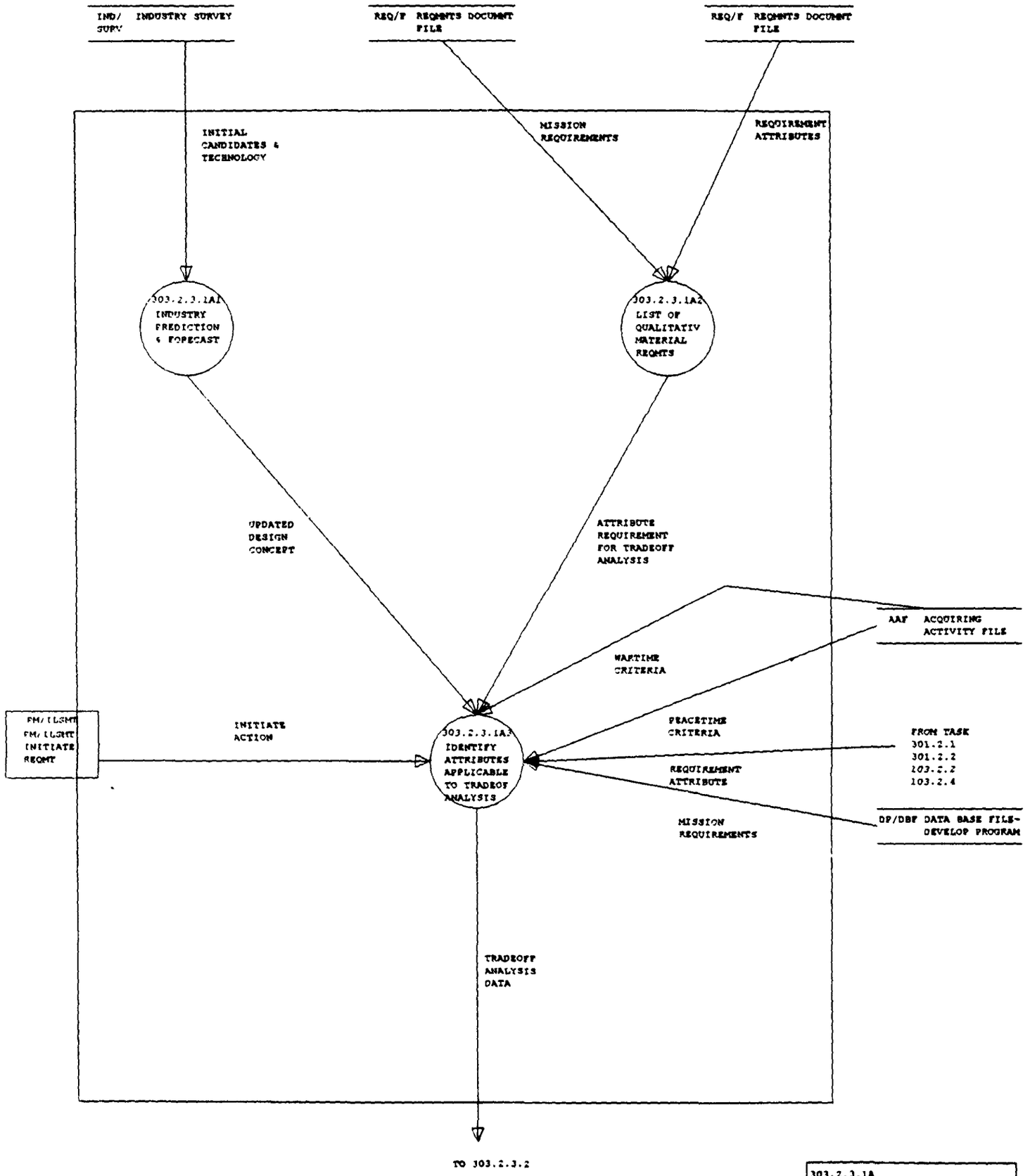
Revised by: SID
Date changed: 28-MAR-90


IND/ SUPV INDUSTRY SURVEY
REQ/F REQMTS DOCUMENT FILE
REQ/F REQMTS DOCUMENT FILE
INITIAL CANDIDATES & TECHNOLOGY
MISSION REQUIREMENTS
REQUIREMENT ATTRIBUTES
303.2.3.1A1 INDUSTRY PREDICTION & FORECAST
303.2.3.1A2 LIST OF QUALITATIV MATERIAL REQMTS
UPDATED DESIGN CONCEPT
ATTRIBUTE REQUIREMENT FOR TRADEOFF ANALYSIS
AAF ACQUIRING ACTIVITY FILE
WARTIME CRITERIA
FM/ LLSMT FM/ LLSMT INITIATE REQMT
INITIATE ACTION
303.2.3.1A3 IDENTIFY ATTRIBUTES APPLICABLE TO TRADEOF ANALYSIS
PEACETIME CRITERIA
FROM TASK 301.2.1 301.2.2 103.2.2 103.2.4
REQUIREMENT ATTRIBUTE
MISSION REQUIREMENTS
DP/DBF DATA BASE FILE- DEVELOP PROGRAM
TRADEOFF ANALYSIS DATA
TO 303.2.3.2
303.2.3.1A
Created by: SID
Revised by: SID
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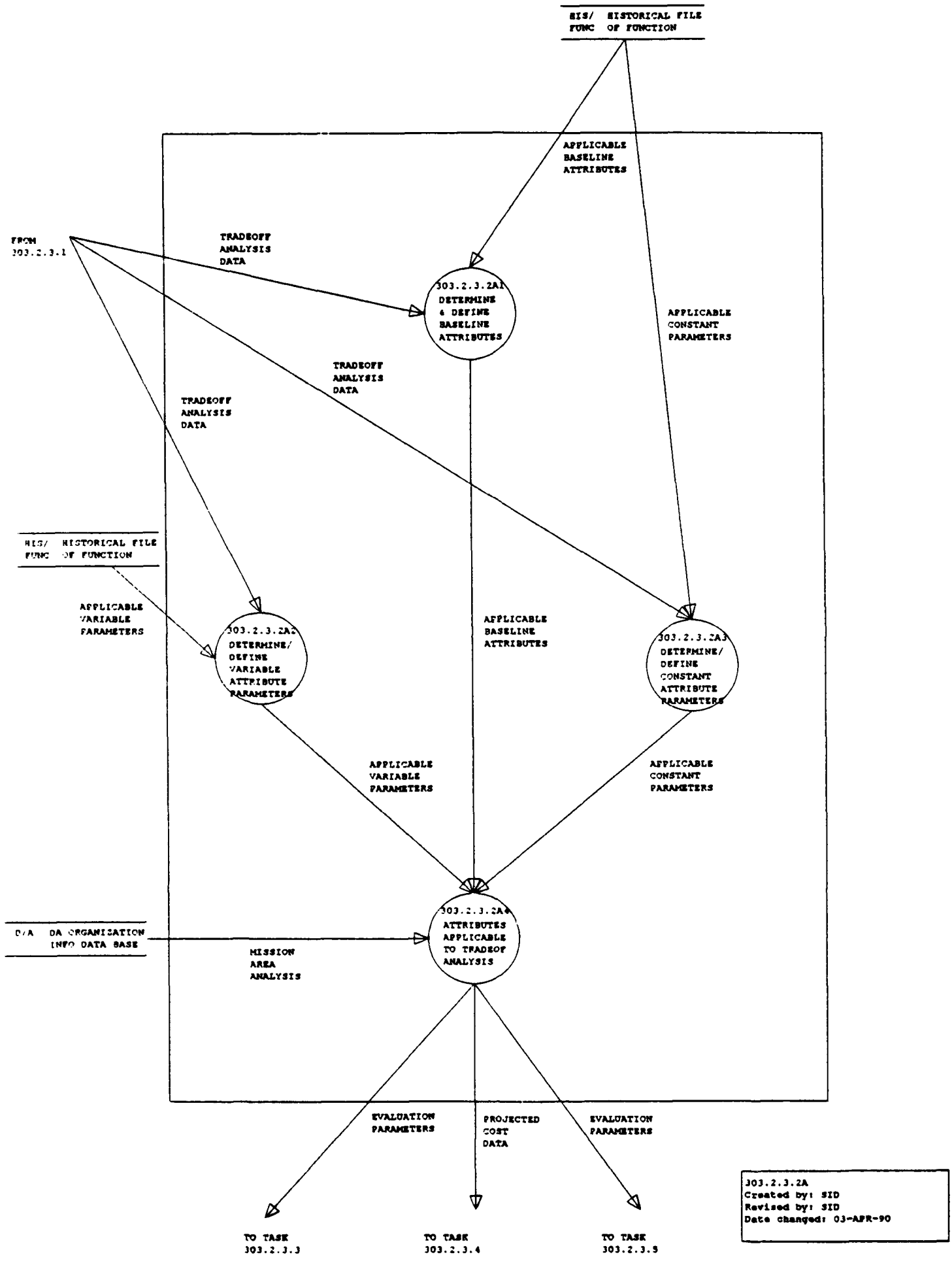
HIS/ FUNC
HISTORICAL FILE OF FUNCTION
APPLICABLE BASELINE ATTRIBUTES
FROM 303.2.3.1
TRADEOFF ANALYSIS DATA
303.2.3.2A1 DETERMINE & DEFINE BASELINE ATTRIBUTES
APPLICABLE CONSTANT PARAMETERS
TRADEOFF ANALYSIS DATA
TRADEOFF ANALYSIS DATA
HIS/ FUNC
HISTORICAL FILE OF FUNCTION
APPLICABLE VARIABLE PARAMETERS
303.2.3.2A2 DETERMINE/ DEFINE VARIABLE ATTRIBUTE PARAMETERS
APPLICABLE BASELINE ATTRIBUTES
303.2.3.2A3 DETERMINE/ DEFINE CONSTANT ATTRIBUTE PARAMETERS
APPLICABLE VARIABLE PARAMETERS
APPLICABLE CONSTANT PARAMETERS
D/A
DA ORGANIZATION INFO DATA BASE
303.2.3.2A4 ATTRIBUTES APPLICABLE TO TRADEOF ANALYSIS
MISSION AREA ANALYSIS
EVALUATION PARAMETERS
PROJECTED COST DATA
EVALUATION PARAMETERS
TO TASK 303.2.3.3
TO TASK 303.2.3.4
TO TASK 303.2.3.5
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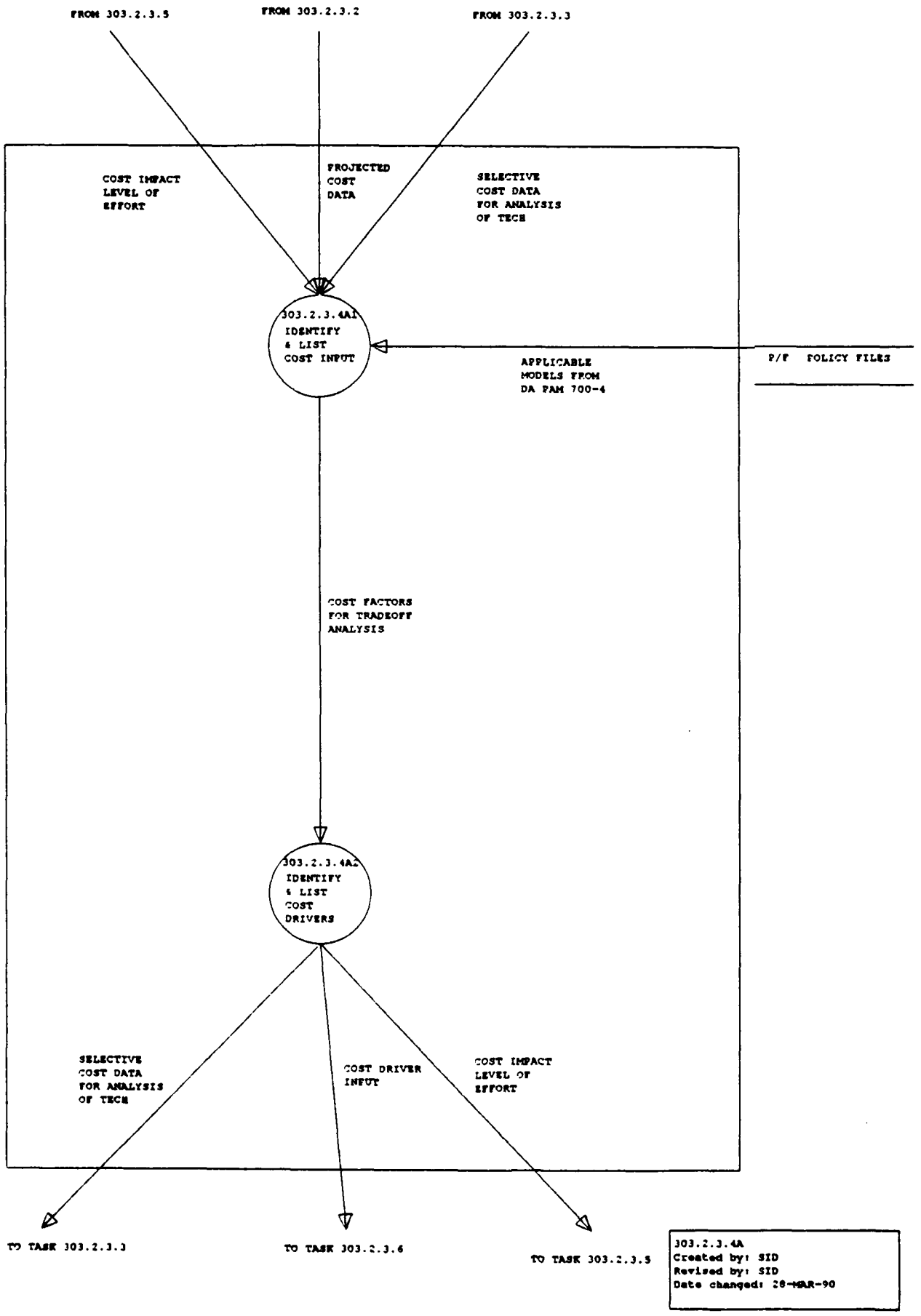
FROM 303.2.3.5
FROM 303.2.3.2
FROM 303.2.3.3
COST IMPACT LEVEL OF EFFORT
PROJECTED COST DATA
SELECTIVE COST DATA FOR ANALYSIS OF TECH
303.2.3.4A1 IDENTIFY & LIST COST INPUT
APPLICABLE MODELS FROM DA PAM 700-4
P/F POLICY FILES
COST FACTORS FOR TRADEOFF ANALYSIS
303.2.3.4A2 IDENTIFY & LIST COST DRIVERS
SELECTIVE COST DATA FOR ANALYSIS OF TECH
COST DRIVER INPUT
COST IMPACT LEVEL OF EFFORT
TO TASK 303.2.3.3
TO TASK 303.2.3.6
TO TASK 303.2.3.5
303.2.3.4A
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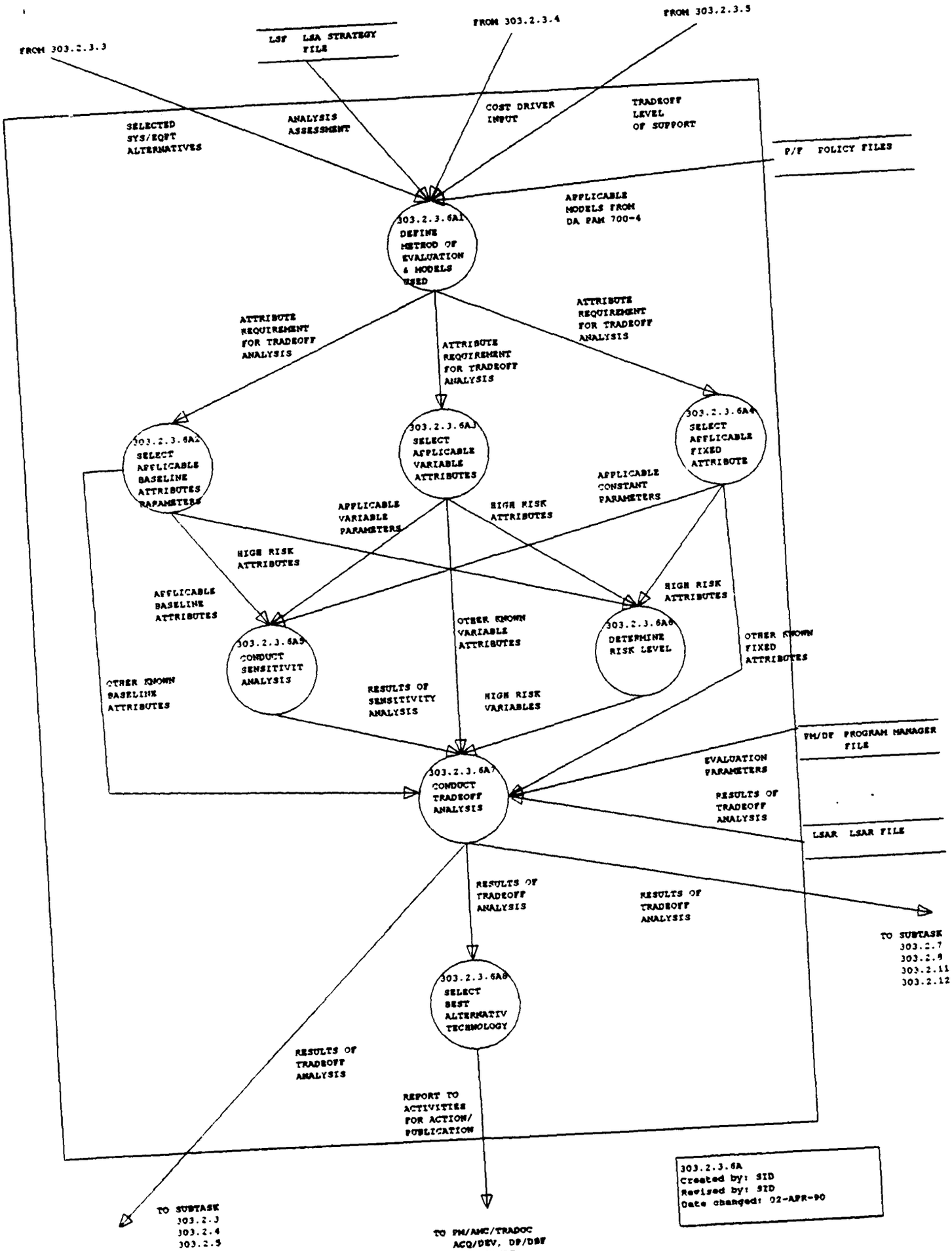
FROM 303.2.3.3
LSF LSA STRATEGY FILE
FROM 303.2.3.4
FROM 303.2.3.5
SELECTED SYS/EQPT ALTERNATIVES
ANALYSIS ASSESSMENT
COST DRIVER INPUT
TRADEOFF LEVEL OF SUPPORT
P/F POLICY FILES
APPLICABLE MODELS FROM DA PAM 700-4
303.2.3.6AI DEFINE METHOD OF EVALUATION & MODELS USED
ATTRIBUTE REQUIREMENT FOR TRADEOFF ANALYSIS
ATTRIBUTE REQUIREMENT FOR TRADEOFF ANALYSIS
ATTRIBUTE REQUIREMENT FOR TRADEOFF ANALYSIS
303.2.3.6AJ SELECT APPLICABLE VARIABLE ATTRIBUTES
303.2.3.6AK SELECT APPLICABLE FIXED ATTRIBUTE
APPLICABLE CONSTANT PARAMETERS
APPLICABLE VARIABLE PARAMETERS
HIGH RISK ATTRIBUTES
HIGH RISK ATTRIBUTES
HIGH RISK ATTRIBUTES
APPLICABLE BASELINE ATTRIBUTES
OTHER KNOWN VARIABLE ATTRIBUTES
OTHER KNOWN FIXED ATTRIBUTES
303.2.3.6AH DETERMINE RISK LEVEL
303.2.3.6AG CONDUCT SENSITIVIT ANALYSIS
OTHER KNOWN BASELINE ATTRIBUTES
RESULTS OF SENSITIVITY ANALYSIS
HIGH RISK VARIABLES
PM/DF PROGRAM MANAGER FILE
EVALUATION PARAMETERS
303.2.3.6AI CONDUCT TRADEOFF ANALYSIS
RESULTS OF TRADEOFF ANALYSIS
LSAR LSAR FILE
RESULTS OF TRADEOFF ANALYSIS
RESULTS OF TRADEOFF ANALYSIS
TO SUBTASK
303.2.7
303.2.9
303.2.11
303.2.12
303.2.3.6AH SELECT BEST ALTERNATIV TECHNOLOGY
RESULTS OF TRADEOFF ANALYSIS
REPORT TO ACTIVITIES FOR ACTION/ PUBLICATION
303.2.3.6A
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Revised by: SID
Date changed: 02-APR-90
TO SUBTASK
303.2.3
303.2.4
303.2.9
TO PM/ANC/TRADOC
ACQ/DEV, DP/DBF
LSF, PM/DF
O/A

Name	Label	Description
303.2.3.1	CONSOLIDAT DATA FOR USE IN TRADEOFF ANALYSIS	This process collects, sorts, and validates system/equipment attributes and technology from state-of-the-art concepts, industry predictions and forecasts and "Baseline" configurations in the form of design alternatives that could be made available to accomplish specific military missions contained in the latest Combat Service Support Mission Area Development Plan CSSMADP and specific Qualitative Materiel Requirements Documents. Applicable data developed from 302.2.1, Functional Requirements 302.2.3, Risks 302.3.5, Design Alternatives
303.2.3.1A1	INDUSTRY PREDICTION & FORECAST	Perform a careful review and survey of the technological advances and design concepts made within the Industry, Research Community and Laboratories within the past several years as well as that predicted for future years when the system/equipment concepts would be operational. This is essential in order to obtain attributes that would be available in the time frame required to satisfy a military requirement. This survey will result in an industry analysis of the advanced technology that would contribute to the accomplishment of the military requirement. These predictions and forecasts of advanced technology, systems and equipment must be based on the mission requirements, operational concepts, doctrine, threat and market investigations of cost identified with the military requirement.
303.2.3.1A2	LIST OF QUALITATIV MATERIAL REQMTS	List performance, reliability, availability, maintainability, operational capability, survivability, sustainability, productivity and cost attributes or parameters specified in the requirements document in order that such factors may be optimized via tradeoff analysis. The parameters in the QMR could be used as the "Baseline" for comparative purposes if no state-of-the-art configuration "Baseline" exists. However, this would impose a problem in comparing state-of-the-art attributes with that forecasted for the new system/equipment as stated in the Military Requirement Document. The best comparison would be to have a present state-of-the-art configuration that lacks advanced technology in meeting military requirements, but would be similar in operational capability to advance concepts.
303.2.3.1A3	IDENTIFY ATTRIBUTES APPLICABLE TO TRADEOF ANALYSIS	This process receives the qualitative materiel requirements (303.2.3.1A2), industry predictions and forecasts (303.2.3.1A1) as well as LSA Reviews developed in processes 103.2.2 and 103.2.4 to identify attributes.

	Name	Label	Description
	303.2.3.2	ESTABLISH AND DEFINE ATTRIBUTES	This process defines and establishes system/equipment attributes that will be used in the tradeoff analysis. Some parameters will be constant and some will vary as attributes are traded off. In order to perform tradeoff analysis during Concept Formulation, it is necessary to establish "Baseline" variable and non-variable (constant) attributes (parameters). It is recognized that a system/equipment does not perform at optimum levels or, is less efficient when forced to have some fixed performance parameters. However, such characteristic limitations are essential to obtain a realistic comparative analysis of performance attributes that are allowed to vary. Some such parameters that could be held constant or allowed to vary based on the specific tradeoff are: a. Speed b. Payload c. Empty Weight d. Endurance e. Accuracy f. Range g. Firepower h. Reliability i. Maintainability j. Supportability k Cost
	303.2.3.2A1	DETERMINE & DEFINE BASELINE ATTRIBUTES	Establish the parameters ofa standard "Baseline" design which approaches meeting the requirements. This will be a starting point for all parameters of interest. The "Baseline" parameters usually come from a fielded system similar to the alternative system/equipment designs. These attributes will be used in comparative analysis to compare "Baseline" to alternative attributes (parameters).
	303.2.3.2A2	DETERMINE/ DEFINE VARIABLE ATTRIBUTE PARAMETERS	Performance, reliability, maintainability, operational capability survivability, productivity and cost attributes must be selected that will vary in system/equipment tradeoff analysis when optimized values are desired. All variable attributes will not be used in any one tradeoff analysis. However, the effect of the change in any attribute in one study may cause a change in other variable parameters used in other tradeoff studies. For this reason, optimization of a design by tradeoffs in one area must be further analyzed to determine its effect on other areas(attributes).
	303.2.3.2A3	DETERMINE/ DEFINE CONSTANT ATTRIBUTE PARAMETERS	Determine performance, reliability, maintainability, operational capability, survivability, productivity and cost attributes(parameters) that will remain constant in the tradeoff analysis. Some such attributes could be: a. Crew size b. Installed Power c. Range d. Pay Load

Name	Label	Description
303.2.3.2A4	ATTRIBUTES APPLICABLE TO TRADEOF ANALYSIS	This process consolidates applicable attributes required for the specific tradeoff analysis. It includes data collected applicable to the specific tradeoff analysis to be performed. This process separates attributes collected that would be required for 303.2.3.3, 303.2.3.4 and 303.2.3.5 for the specific analysis
303.2.3.3	PRELIM ANALYSIS OF TECH	This analysis takes the technologies which could contribute to the accomplishment of the required military missions and selects specific attributes that such technology must satisfy. Each technology is then screened (rated) by an analytical hierarchy process to determine which technologies or configurations are viable candidates. Attributes that could be used for this initial screening are: a. Sustainability - Compatibility with Army management, supply and personnel training systems. b. Payload - Capability to transport items of equipment, personnel, or mission functions as listed in mission requirement documents. c. Cost - R & D, procurement, operations support and maintenance cost.
303.2.3.4	IDENTIFY COST FORMULA	This process develops the cost formula that will be used. It will be expressed in recognizable units which can be applied uniformly to all of the configurations/systems/hardware when attributes are traded off in the analysis.
303.2.3.4A1	IDENTIFY & LIST COST INPUT	Provide performance, design, maintainability, and supportability cost input numerics for cost tradeoff studies.
303.2.3.4A2	IDENTIFY & LIST COST DRIVERS	Determine those attributes that when traded off have the largest effects on operations, development and support cost through the system/equipment intended life cycle. These will be high cost drivers due to system/equipment state-of-the-art design concepts that have very little cost data on record. Data must be obtained from "Baseline" or analytical cost formula that produces high cost drivers as part of its output.
303.2.3.5	ESTABLISH LEVEL OF EFFORT	This process defines the level of effort to be used in the tradeoff process consistant with the level of system/equipment attribute definitions available. The level of effort will be at a lower level during concept formulation than what it would be during production or fielding of the system/equipment because projections and state-of-the-art forecasts have to be made in concept formulation. Some tradeoffs during concept formulation and development are established by estimations. Refined estimates represent the traditional means of establishing cost tradeoffs, schedule tradeoffs and tradeoffs between cost and schedule. Such tradeoffs require very little effort. However, when such estimates are made the uncertainty level should be stated. Example: 30% of the activity can be estimated within 50%.

	Name	Label	Description
	303.2.3.6	CONDUCT TRADE OFF ANALYSIS	Using the results of the consolidated data on state-of-the-art concepts in 303.2.3.1, the attributes established in 303.2.3.2, the preliminary analysis data in 303.2.3.3 on selected candidates and the cost formula developed in 303.2.3.4 determine the attribute (parameter) values that will be used in determining the technologies selected in 303.2.3.3 that best meet the support, performance, logistics, fielding and cost requirements and still meet the military mission requirements. There will be multiple iterations of this process as the system/equipment, applicable to these tradeoff analyses, progresses through it's life cycle. When this occurs a complete review of input and output data, processes and data flows will be necessary as some of the variable and constant attributes will have changed in value caused generally by design changes. Make recommendations, based on tradeoffs made, as to the best state-of-the-art concept for satisfying the system/equipment military requirements.
	303.2.3.6A1	DEFINE METHOD OF EVALUATION & MODELS USED	Construct analytical relationships that will be used in comparing each concept. Using data from 303.2.3.3, 303.2.3.4 and 303.2.3.5. Review AMC-P 700-4 or equivalent for applicable models that could be used in determining the most feasible tradeoff requirements for optimization of the technology under analysis.
	303.2.3.6A2	SELECT APPLICABLE BASELINE ATTRIBUTES PARAMETERS	Examine the model specification of an existing similar but fielded system/equipment and select "Baseline" values of performance, reliability, maintainability, supportability and readiness attributes. If a comparative evaluation tradeoff instead of a finite evaluation tradeoff of the systems/equipments attributes is desired, a value of 1.00 is assigned to each "Baseline" attribute. Calculated attribute values from state-of-the-art technologies are then assigned values in excess of or below 1.00 based on their relative value with respect to the "Baseline" of 1.00. As a result, all values developed would be comparative rather than finite. However, finite values and changes due to tradeoffs may be more easily evaluated and "Baseline" comparisons unnecessary.
	303.2.3.6A3	SELECT APPLICABLE VARIABLE ATTRIBUTES	Identify the attributes(parameters) contained in industry prediction and forecast and in 303.2.3.6A1 that are applicable to the particular tradeoff analysis. Determine either by applicable models or prepared plots of attribute variations the effects of changes in variable attributes. Based on these variations, record and describe the effect and magnetude of changes in terms of optimization.

Name	Label	Description
303.2.3.6A4	SELECT APPLICABLE FIXED ATTRIBUTE	In order to make certain tradeoff analysis it is necessary to establish some attributes at fixed values as other attributes are varied. As an example: Tradeoffs in certain attributes are made on the bases of a constant oayload, identical hours of endurance, etc.. It is recognized that a system/equipment will not operate as efficiently when limited to such fixed attributes, however, from the standpoint of the tradeoff analysis, constant attributes make very little difference in the comparative effects of the variables as they are changed. However, such constants do allow for a better and more realistic comparison of attributes traded off and allows for a more practical procedure for optimization.
303.2.3.6A5	CONDUCT SENSITIVIT ANALYSIS	This process involves conducting a sensitivity analysis to identify performance, design, reliability, maintainability, supportability and cost attributes (parameters) that are influenced by variations in any of the listed attributes. The process/analysis identifies those areas where major changes in any of the attributes effects performance, design, supportability, produceability and cost and identifies the major drivers. Source of Data: 303.2.3.2A2 - Variable Attributes 303.2.3.2A3 - Constant Attributes 303.2.3.3 - Preliminary Analysis of Technologies
303.2.3.6A6	DETERMINE RISK LEVEL	This process involves the assessment of risks in the changes of variable attributes during the tradeoff analysis as well as during the selection process of optimum technologies. As tradeoffs are made, consideration of the corresponding risk factors becomes essential particularly during the concept formulation and development cycle. Source of Data: 303.2.3.2A2 - Variable attributes 303.2.3.3 - Preliminary Analysis of Technologies 303.2.3.6A1 - Define Method of Evaluation and Models Used
303.2.3.6A7	CONDUCT TRADEOFF ANALYSIS	Using the results of the consolidated data on state-of-the-art concepts, the "Baseline", variable/constant attributes established, and considering the risk level and cost drivers, perform tradeoffs in attributes until values are obtained that will best allow for the system/equipment to meet the performance, support, logistics, fielding and cost requirements of the required military missions and the Qualitative Materiel Requirements (QMR). Make recommendations based on tradeoffs made as to the best state-of-the-art concept for satisfying and exceeding the military mission requirements. Source of Data: 303.2.3.1 - Consolidate Data for use in Tradeoffs 303.2.3.2 - Establish and Define Attributes 303.2.3.4A2 - Identify and List Unique Cost Drivers 303.2.3.5 - Establish Level of Effort

	Name	Label	Description
	303.2.3.6A8	SELECT BEST ALTERNATIV TECHNOLOGY	Evaluate the results of the tradeoff and sensitivity analysis of the selected alternative technologies and select the most appropriate technology from the tradeoffs applied. Source of Data: 303.2.3.6A5 - Conduct Sensitivity Analysis 303.2.3.6A6 - Determine Risk Level 303.2.3.6A7 - Conduct Tradeoff Analysis 303.2.3.4 - Identify Cost Formula
	303.2.3.7	DOCUMENT RESULTS	Document in narrative format the alternative configuration determined to be the most optimum based on the tradeoffs made. If the tradeoff only envolved design, production or functional changes of the system/equipment then list each change made and its effect on each of the alternate systems/equipment. Rank each alternative configuration or system changes on the configurations in numerical sequence (Best as No. 1 and worst as last No.) and state why each was considered at the specific rating. Results must include recommendations for the alternative system/equipment and/or factor selected and explanations of the effect of tradeoff results on the system/equipment.

Name	Label	Description
ANAL/ASSESS	ANALYSIS ASSESSMENT	Purpose: Data containing attribute values that could possibly be used in early Tradeoff Analysis. The data contains assessments of the following: 1. Probable design concept. 2. Preliminary design analysis. 3. Design freedom. Source of Data: 1. LSA Strategy File 2. Industry Survey
APP/BASL/ATT	APPLICABLE BASELINE ATTRIBUTES	Purpose of Data: Historical data in the form of attributes (parameters) for a design and logistically similar system/equipment pertaining to the "Baseline" systems performance, reliability, maintainability, supportability, produceability and cost that can be used in a comparative analysis between "Baseline" and alternative system/eqpmt. attributes to show the comparative values of changes made in tradeoff analysis. If a comparative value tradeoff instead of a finite value tradeoff of the system/equipment is desired, a value of 1.00 is assigned to each "Baseline" attribute calculated. Source of Data: Historical Data File for a Logistically Similar System/Equipment
APP/CONST/PAR	APPLICABLE CONSTANT PARAMETERS	Purpose: Data identifying specific attributes (parameters) to be used in tradeoff analysis that remain constant in order to make comparative analysis of alternate systems/equipment. The alternate designs will have attributes calculated on the bases of identical payload, identical altitude, power required & etc.. To obtain a realistic comparative evaluation of various tradeoffs. It is recognized that the alternate designs will not operate as comfortably or efficiently under such conditions. But, from the standpoint of comparative analysis, these minor adjustments make little difference in the ratios between the respective alternate designs. Source of Data: 1. Industry Survey 2. Acquiring Activity Data File 3. Development Program Data Base 4. Historical Data File
APP/MOD/AMC-P700-4	APPLICABLE MODELS FROM DA PAM 700-4	Purpose: Applicable models used as a guide for constructing an analytical model in determining the most feasible tradeoffs for the alternative system/equipment under analysis to obtain the most optimum attributes. Source of Data: DA-PAM 700-4 (Logistic Support Analysis Techniques Guide ..... and Equivalent Documentation of File.

Name	Label	Description
APP/VAR/PAR	APPLICABLE VARIABLE PARAMETERS	Purpose: Data identifying specific attributes (parameters) to be used in tradeoff analysis that will have values changed in order to determine optimum values of such variable attributes. These values also be compared with "Baseline" attributes in comparative analysis in order to present comparative evaluations of tradeoffs for each alternative state-of-the-art design. Source of Data: 1. Industry Survey 2. Acquiring Activity Data File 3. Developoment Program Data Base File 4. Historical Data File
ATT/REQ/TOA	ATTRIBUTE REQUIREMENT FOR TRADEOFF ANALYSIS	Purpose: A listing of attributes that must be met by the alternate systems/equipments in order for the system/equipment to conceptionally meet specific qualitative materiel requirements. Such attributes include: 1. Performance attributes a. Range Reqmt. b. Max Speed c. Minimum turn around radius d. Etc.. 2. Supportability Attributes a. Reliability attributes b. Maintainability attributes c. Operational and Support Cost d. Logistic Support Resources Source of Data: 1. Qualitative Materiel Requirements (QMR) 2. Required Operational Objectives 3. Acquiring Activity File
BSL/SUPP/PAR	BASELINE SUPPORTABIL-ITY PARAMETERS	Purpose: Historical data for a "Baseline" configuration and all alternative proposed designs pertaining to performance, reliability, maintainability, supportability, produceability and cost that must be considered prior to performing any tradeoff analysis. Source of Data: 1. 203.2.1 Identify Comparative Systems 2. 203.2.2 Baseline Comparison Systems 3. Historical Data File (Hist/File) 4. Historical File of Functions (His/Func) 5. LSAR File. Will give data for Baseline/Comparative Systems. 6. AAF and PM Data Stores. Will give like data on alternate systems. Application: 1. Provides attributes needed for the various tradeoff analysis to be performed. 2. Provides data for comparative analysis or preparation of curves/graphs that shows variations in attributes as tradeoffs occur.

Name	Label	Description
COST/DRIVER/INPUT	COST DRIVER INPUT	Purpose: Data identifying those "high drivers" that have a large effect on the cost of developing, producing, supporting and operating the alternative system/equipment. Source of Data: 1. 303.2.5.4A25 Unique Cost Drivers 2. AAF Aquiring Activity File for Costs & Operational Effectiveness Analysis data (COEA) and projected cost data. 3. DP/DBF File for cost estimating relationships models i.e. Cost of LSA Tasks.
COST/FAC/TOA	COST FACTORS FOR TRADEOFF ANALYSIS	Purpose: Data identifying cost factors to be used in tradeoff analysis. In development and concept formulation such factors would include cost of design, testing, evaluation, documentation and the relative burden of program management, engineering support, etc.. For a tradeoff analysis during production and/or fielding, cost factors such as logistics, maintenance, training and production would be included. All of these inputs come from the sources listed that are providing inputs to Task 303.2.3.4A1. Source of Data: 1. Acquiring Activity File 2. Development Program Data Base File 3. Historical Data File 4. Industry Survey
COST/IMP/LVL/EFFORT	COST IMPACT LEVEL OF EFFORT	Purpose: To supply the analyst with cost data required to establish level of effort that could have an effect on the cost formula. The data shall contain as the least a copy of the actual updated independent parametric cost estimate. Early in Concept Formulation such data may not be available. However, cost data from Industry Surveys and the PM's Data File would be available in order to determine level of effort of tradeoff analysis as it effects cost. Such cost data/effort would be fed back into the cost formula (303.2.3.4) by the analyst to contribute to the overall program cost if determined to be significant. Attributes established and defined for applicable tradeoff analysis are inputs 303.2.3.4(Cost Formula). The output from 303.2.3.4 would be changes due to inputs there cost impact on level of effort. Source of Data: 1. Program Managers Data File (PM/DF 2. Industry Survey 3. COA/AMC

	Name	Label	Description
	DOC/RES/TOA	DOCUMENTED RESULTS OF TRADEOFF ANALYSIS	Purpose: Data identifies and shows results of evaluation criteria used, analytical relationships and models (Ref. Subtask 303.2.3.6) used and justification of selected best alternative system/component with sensitivity analysis results and any risks envolved in each of the alternative system/equipment design concepts. A comparison of total costs of each alternative system or equipment is also shown with reasons for the selection of the best alternative system/equipment. Source of Data: 1. Subtask 303.2.3.6A1 for evaluation criteria and models used. 2. Subtask 303.2.3.6A5 for sensitivity analysis results. 3. Subtask 303.2.3.6A6 for risk analysis for the selected alternative system/ equipment. 4. Industry Survey 5. Historical File on Cost Data previously acquired on alternate systems/equipment.
	EVAL/PAR	EVALUATION PARAMETERS	Purpose: Historical Data for a Logistically similar system/equipment pertaining to restrictions/limitations (i.e. existing personnel, manpower, cost, etc.) that must be considered prior to constructing peraonnel and manpower models for analysis. Source of Data: Historical Data File
	EVAL/PARA	EVALUATION PARAMETERS	PURPOSE: HISTORICAL DATA FOR A LOGISTICALLY SIMILAR SYSTEM/EQUIPMENT PERTAINING RESTRICTIONS/LIMTATIONS (i.e., EXISTING PERSONNEL, UNIQUE PERSONNEL, MANPOWER, COST, ETC.) THAT MUST BE CONSIDERED PRIOR TO CONSTRUCTING PERSONNEL & MANPOWER MODELS FOR ANALYSIS. SOURCE OF DATA: HISTORICAL DATA FILE
	FUNC/REQ/OPER/SUPP	FUNCTIONAL REQUIREMENTS OPERATIONAL SUPPORT	Purpose: Descriptive data of: 1. What the new system/equipment must do in order to accomplish intended mission or tasks. 2. Unique functions due to new technology in the design or new operational concepts. 3. Identification of risk involved with the supportability of the system/eqmt. due to functional requirements. 4. Operation and maintenance tasks that must be performed in order for the alternate system/eqmt. To be able to accomplish the identified functions. 5. Design alternatives which reduces or simplifies functions requiring logistic support resources. Source of Data: 1. 301.2.1 Functional Requirements 2. 301.2.2 Unique Functional Reqmts. 3. 301.2.3 Risks 4. 301.2.4 Operations & Tasks 5. 301.2.5 Design Alternatives

Name	Label	Description
FUNC/REQ/SYS/EQPT	FUNCTIONAL REQMTS SELEC SYSTEM/EQPT	Purpose: A list of functional and support fixed, variable and "Baseline" attributes that identifies each alternative system/ equipments capabilities to accomplish the required military mission. This data will be more than that required by to do specific tradeoff analysis. However, the data will consist of that required for any tradeoff analysis and the preliminary analysis will include the selection of such data applicable for specific tradeoff analysis. 1. Functional Requirements - examples a. Cruise Speed b. Pay Load c. Range d. provide Life Support to the Crew 2. Maintenance Support Examples a. Service/Repair b. Scheduled/unscheduled Tasks c. Overhaul d. Component Reliability Source of Data: 1. 302.2.5 (Identification of System/ Equipment functional and support requirements) 2. Industry Survey 3. Required Operational Capabilities ROC 4. Qualitative Materiel Requirements QMR
HRSK/ATT	HIGH RISK ATTRIBUTES	Purpose: Data containing qualitative and quantitative high risk parameters related to performance, reliability, maintainability, supportability, produceability and cost attributes. Source of Data: 1. Subtask 303.2.3.6A2 2. Industry Survey
HRSK/VAR	HIGH RISK VARIABLES	Purpose: Data contains identified qualitative and quantitative risk attributes for each alternative design. This includes estimated attributes and each level of risk. Source of Data: 1. Subtask 303.2.3.6A2 2. Subtask 303.2.3.6A3 3. Subtask 303.2.3.6A4 4. Industry Survey

Name	Label	Description
INIT/ACT	INITIATE ACTION	Purpose: Direction and data from the Program Manager responsible for the system/equipment that requires a tradeoff analysis to be performed. The key action required is the directive authority that allows the analyst to initiate the action for a tradeoff analysis. This action also involves the analyst in becoming familiar with system design data and drawings that describes each systems internal and interface functions beginning at system level and progressing to the lowest indenture level of the system/equipment. Source of Data: 1. Policy files 2. Program Manager Data File (PM/DF)
INIT/CAND/TECH	INITIAL CANDIDATES & TECHNOLOGY	Purpose: Data identifying the performance, reliability, maintainability, supportability, produceability and cost attributes of each alternate design. This need is based of the requirement for certain tradeoffs to be made in specific variable attributes Source of Data: 1. Industry Survey 2 Acquiring Activity File 3. Data Base File-Development Program
MIS/AR/ANAL	MISSION AREA ANALYSIS	Purpose: Data pertaining to mission area analysis that establishes attributes (performance characteristics) that must achieve a specific performance level to allow the system/equipment to meet the required mission performance. This data is related to the development program for each alternate system/equipment and is obtained from the data base file or industry survey related to advanced technology. Source of Data: 1. Qualitative Materiel Requirements 2. Required Operational Objectives 3. Industry Survey 4. Data File of Development Programs

Name	Label	Description
MIS/REQ	MISSION REQUIREMENTS	Purpose: Data containing mission area requirements that must be achieved by the alternate system/equipmentnfor the analyst to consider if tradeoff analysis deals with performance, reliability, maintainability, supportability, produceability and cost attributes. This data is needed to insure that changes in attributes during tradeoff analysis does not result in reduced capability to perform the system/equipments required mission. The data also informs the analyst of the alternate system/equipments system definition which is essential in tradeoff analysis that may effect mission accomplishments. The system definition is a functional developed for each mission, times and developed for each mission, times and equipment utilization. functions and output of each item and conditions which constitutes system and parts failure. Source of Data: 1. Reqd. Operational Capabilities Doc. 2. Qualitative Materiel Requirement 3. Industry Survey 4. Acquiring Activity File
OT/KNOWN/BASL/ATT	OTHER KNOWN BASELINE ATTRIBUTES	Purpose: Data contains "Baseline" attributes to be used in tradeoff analysis with negligible sensitivity or risk involved it values are incorrect. Source of Data: Sub Task 303.2.3.6A2 Establish & Define Attributes
OT/KNOWN/FIX/ATT	OTHER KNOWN FIXED ATTRIBUTES	Purpose: Data contains fixed or constant attributes to be used in tradeoff analysis with negligible sensitivity or risk envolved it values are incorrect. These attributes are not used in sensitivity or risk analysis. Source of Data: Sub Task 303.2.3.6A4 Establish & Define Attributes
OT/KNOWN/VAR/ATT	OTHER KNOWN VARIABLE ATTRIBUTES	Purpose: Data contains "variable" attributes to be used in tradeoff analysis with negligible sensitivity or risk involved if values are incorrect. Source of Data: Sub Task 303.2.3.6A3 Establish & Define Attributes
PEACE/CRIT	PEACETIME CRITERIA	Purpose: Data identifies peacetime standards that must be applied to the alternate designs and tradeoff analysis. This data includes climatic conditions described in MIL-STD-210C and identifies environments in which the alternate systems/equipment must operate in order to accomplish it's intended mission. 1. Readiness (preparation time). 2. Standards for storage (time, location, etc.) 3. Climatic Conditions Source of Data: 1. Acquiring Activity File 2. MIL-STD-210C

Name	Label	Description
PROJ/COST/DATA	PROJECTED COST DATA	Purpose: To supply the analyst with the cost of operating, developing, and supporting the systems/equipment through their projected life cycle. Identify the predicted/estimated costs that have high risk factors related to new technology or new support equipment. Source of Data: 1. Acquiring Activity File that has projected cost data and COEA Data. 2. Industry Survey Data on each alternate system/equipment.
REP/ACTIVITY/ACT/PUB	REPORT TO ACTIVITIES FOR ACTION/ PUBLICATION	Purpose: Data flow contains a draft report prepared by the analyst with the performance, reliability, maintainability, serviceability, produceability, system readiness and operating cost for the selected system/equipment with a narrative that specifically describes the reasons for selecting the preferred system/equipment. If the task only envolved the change in attributes that effects any of the above factors the report will describe in detail the effect, risk and sensitivity of the changes and why a specific tradeoff was selected. The report should also identify areas of marginal and state-of-the-art design explaining any design compromises and operating restrictions and why each was agreed upon. Source of Data: Subtask 303.2.3.6A8 (Select Best Alternative Technology)
REQ/ATTRIB	REQUIREMENT ATTRIBUTES	Data containing the required performance, reliability, maintainability, supportability, produceabilaity and cost attributes considered essential for the system/equipment to be able to meet the requirements of the weapon system military mission. Source of Data: 1. Subtask No. 301.2.1 Functional Requirements 2. Subtask No. 301.2.2 Unique Functional Requirements 3. Subtask No. 301.2.3 Risks
RES/BACK/PROC/INPUTS	PASS RESULTS BACK TO PROCESS GIVING INPUT	Purpose of Data: This Data Flow contains the documented results of the Design, Operations and Support Trade-off Analysis. The results are passed back to update other LSA Tasks 303 Trade-off Analysis which have been affected.
RES/RSK/ANAL	RESULTS OF RISK ANALYSIS	Purpose: Data contains optimum balance between the applicable variable attributes used and those contained in each alternate design/system/equipment including a comparison of each alternative design with the "Baseline" configuration. Source of Data: 1. 303.2.3.6 Conduct Tradeoff Anal.
RES/SENS/ANAL	RESULTS OF SENSITIVITY ANALYSIS	Purpose: Provide the analyst with data containing performance, reliability, maintainability, supportability, produceability, and cost attributes that are influenced by changes in operations and/or support parameters (attributes) that identifies major sensitivity drivers. Source of Data: 1. 303.2.3.6 Conduct Tradeoff Analysis

Name	Label	Description
RES/TOA	RESULTS OF TRADEOFF ANALYSIS	Purpose: Data contains optimum balance between the applicable variable attributes used and those contained in each alternate design/system/equipment including a comparison of each alternative design with the "Baseline" configuration. Source of Data: 1. 303.2.3.6 Conduct Tradeoff Analysis.
SEL/COST/DATA/FOR/AN	SELECTIVE COST DATA FOR ANALYSIS OF TECH	Purpose: Data identifying those "high drivers" that have a large effect on the cost of operating & supporting the alternate system/equipment, or are required to perform specific tradeoff analysis. These "high drivers" are required regardless of specific (parameter) costs incurred. Attributes established in Subtask 303.2.3.2 to be used in Subtask 303.2.3.3 (Preliminary Analysis of Technology) relating to cost would be the input data to 303.2.3.4 (Identify Cost Formula). The output from 303.2.3.4 would be any changes in cost that would be input to 303.2.3.3 (Preliminary Analysis of Technology). Source of Data: 303.2.3.4A2 Identiofy List of Cost Drivers
SEL/SYS/EQPT/ALT	SELECTED SYS/EQPT ALTERNATIVES	Purpose: Provides analyst with documented results of evaluations and technical data in order to come up with configurations that are closest to meeting the military requirements. Source of Data: Industry Survey, Proposals and Program Management Documentation Application: 1. Selects specific attributes that each technology (alternate design) must satisfy. 2. Screens candidates to determine which are viable for tradeoff analysis.
TO/EVAL/UPDATES	TRADEOFF/ EVALUATION UPDATES	Purpose of Data: This Data Flow contains the Tradeoff Evaluation Results which are used to update LSA Task 301, "System/Equipment Functional Requirements Identification" and 303 "Trade-off Analysis" that are affected by this analysis. Source of Data: 303.2.3.6 Conduct Tradeoff Analysis
TO/LVL/SUP	TRADEOFF LEVEL OF SUPPORT	Purpose: Data containing a description of the level of effort possible and determined in 303.2.3.5 for tradeoff analysis in terms of what variable and fixed attributes are available from 303.2.3.2 for an analysis. The data also identifies the "high drivers" that have a large effect on reliability, maintainability, supportability and readiness of the alternative system/equipment Source of Data: 1. 303.2.3. Readiness Sensitivity 2. LSA Strategy File 3. Industry Survey

	Name	Label	Description
	TOA/DATA	TRADEOFF ANALYSIS DATA	Purpose: Consists of data on the performance, maintainability, Reliability, supportability, produceability and cost that have been determined to be baseline, variable or fixed attributes as they apply to the specific tradeoff analysis. For example: In several tradeoff analysis, gross weight will be held constant while speed changes to find the effect on system range. This data will also consist of areas of marginal and state-of-the-art design and explain any design compromises and operating restraints. This information will aid in determining the possible tradeoff analysis's that are required. Source of Data: 1. AAF Acquiring Activity File 2. Development Program Data Base File 3. Industry Survey 4. Input from Task 303.2.3.1
	UP/DESN /CONCEPT	UPDATED DESIGN CONCEPT	Purpose: Updated design concepts that better define the advantages and disadvantages of each alternative concept for the analyst and provides useable information usable information as to which alternative is most responsive to the tradeoff applied. Source of Data: 303.2.3.1A1 Industry Predictions & Forecasts
	WAR/CRIT	WARTIME CRITERIA	Purpose: Data for the analyst that shows those geographic areas which present potential war time areas of operations. The data identifies environments in which the alternate system/equipment must operate in order to accomplish it's intended mission(s). Data includes climatic conditions as described in MIL-STD-210C and if applicable, must be considered during tradeoff analysis. Source of Data: 1. Acquiring Activity File 2. MIL-STD-210C

Name	Label	Description
AAF	ACQUIRING ACTIVITY FILE	Contains those records, documents, decision papers, schedules that were prepared as part of the acquisition initiation, justification, and planning prior to the assignment of a Project Manager. The items in this data store includes: a. Threat analysis data. b. O & O Plan. c. Functional objectives data. d. Functional requirements data. e. Projected schedule data. f. Logistics resources data. g. Desired R & M parameters. h. TOA i. TOD j. Cost and operational effectiveness analysis (COEA) data. k. Projected cost data l. Justification of major system new start (JMSNS) data. m. Required operational capability (if prepared prior to assignment of program manager-else found in PM files.
D/A	DA ORGANIZATION INFO DATA BASE	Contains the listing of potential team members of TRADOC and AMC, specified by their area of expertise, name, address, P.O.C., and other pertinent information needed for selection of specific LSA Tasks and Subtasks that will be required for the development program. The list also includes names of personnel considered to be expert in specific state-of-the-art technologies.
DP/DBF	DATA BASE FILE-DEVELOP PROGRAM	This store contains those papers, files, analysis results which are related to the development program and which will be useful for establishing required relationships, trends, etc., for the development program which will be effected by certain tradeoff analysis. This store contains such items as: a. Mission area analysis results. b. Historical file-LSA task cost requirements. c. Historical file-LSA task cost requirements. d. Historical file-Maintenance experience of similar items. e. Cost estimating relationships (CER'S) models re. cost of LSA tasks.
HIS/FUNC	HISTORICAL FILE OF FUNCTION	Contains a historical record of operational, maintenance and support functions of item/equipment that can be used as a "Baseline" to forecast or predict the functional requirements and/or the characteristics of the developmental item/equipment.

	Name	Label	Description
	IND/SURV	INDUSTRY SURVEY	Since systems/equipments are designed by contractors(developers) and not in-house, briefings or industry surveys should be requested from all major system/equipment developers to learn what they know concerning present and future technologies that could be applied to the proposed system/equipment including the developers cost effectiveness analysis of his state-of-the-art technology. Each developers presentation or survey should be assessed in terms of general principles (is it applicable to meeting the military requirement?) and what influence each proposed configuration exhibits that influences or contributes to state-of-the-art technology. Estimated/predicted attributes(parameters) are obtained for each proposed development.
	LSAR	LSAR FILE	The Logistic Support Analysis File (LSAR) or record holding area contains LSA Task Reports or the equivalent (LSAR Master Record Sheet Information or LSAR Report). When the system is automated it contains logistic data which can be used to assess various ILS elements. MIL-STD 1388-1A and 1388-2A should be looked at for complete outputs.
	LSF	LSA STRATEGY FILE	The LSA strategy files contain those prerequisites to the development of the system/equipment early program LSA/ILS strategy and will have attribute values that can be used in early tradeoff analysis. These files contain analysis and assessments in the following areas: a. Use studies or similar items, in particular the "Baseline" or item being replaced. b. Probable design c. Preliminary design analysis for each alternative system. d. Type of acquisition e. Design freedom f. Degree of new technology g. Historical data review (similar system). h. Constraints analysis. i. Work already accomplished.

Name	Label	Description
P/F	POLICY FILES	CONTAINS THOSE MILITARY PUBLICATIONS, DECISION PAPERS, MISSIONS & FUNCTIONS, etc, WHICH ARE NEEDED TO ESTABLISH THE LOGISTICAL SUPPORT AND REVIEW REQUIREMENTS OF THE ITEM/EQUIPMENT DEVELOPMENT PROGRAM. THIS DATA STORE INCLUDES: 1. AR 12-16, "MUTUAL LOGISTICS SUPPORT BETWEEN THE U.S. AND OTHER NORTH ATLANTIC TREATY ORGANIZATION FORCES" 1a. AR 70-1, "SYSTEMS ACQUISITION POLICY AND PROCEDURES" 1b. AR 70-2, "RESEARCH, DEVELOPMENT, & ACQUISITION MATERIEL STATUS RECORDING" 1c. AR 70-10, "R&D - TEST & EVALUATION DURING DEVELOPMENT AND ACQUISITION OF MATERIEL" 1d. "AR 570-9, "MANPOWER AND EQUIPMENT CONTROL - HOST NATION SUPPORT" 2. AR 700-9, "POLICIES OF THE ARMY LOGISTIC SYSTEM" 3. AR 700-82, "JOINT REGULATION GOVERNING THE USE AND APPLICATION OF UNIFORM SOURCE MAINTENANCE AND RECOVERABILITY CODES" 4. AR 700-127, "INTEGRATED LOGISTICS SUPPPORT" 5. AR 725-50, "REQUISITIONING, RECEIPT AND ISSUE SYSTEM" 6. AR 750-1, "MAINTENANCE OF SUPPLIES & EQUIPMENT - ARMY MATERIEL MAINTENANCE CONCEPTS & POLICIES" 7. AMC-R-700-27, "LEVEL OF REPAIR ANALYSIS (LORA) PROGRAM" 8. AMC-R-750-10, "DEPOT MAINTENANCE INTERSERVICE" 9 DA PAM 700-4 10. DA PAM 700-26, "INTEGRATED LOGISTIC SUPPORT PROGRAM ASSESSMENT ISSUES AND CRITERIA" 11. DA PAM 700-50, "INTEGRATED LOGISTIC SUPPORT - DEVELOPMENTAL SUPPORTABILITY TEST AND EVALUATION GUIDE" 12. DA PAM 700-55, "INSTRUCTIONS FOR PREPARING THE INTEGRATED LOGISTIC SUPPORT PLAN" 12a. DA PAM 738-750, "THE ARMY MAINTENANCE MANAGEMENT SYSTEMS (TAMMS)" 13. DA PAM 750-21, "LOGISTIC SUPPORT MODELLING" 14. AMC PAM 700-4, "LOGISTICS SUPPORT ANALYSIS TECHNIQUES GUIDE (WITH PALMAN)" 14a. AMC PAM 700-11, "LOGISTICS SUPPORT ANALYSIS REVIEW TEAM GUIDE" 15. AMC PAM 750-2, "MAINTENANCE OF SUPPLIES AND EQUIPMENT GUIDE TO RELIABILITY CENTERED MAINTENANCE" 16. MIL-STD-152, "TECH REVIEW GUIDELINES" 17. MIL-STD-210A, "CLIMATIC EXTREMES FOR MILITARY EQUIPMENT" 18. MIL-STD-470, -471, "MAINTAINABILITY STANDARDS" 19. MIL-STD-756, "RELIABILITY MODELLING & PREDICTIONS" 20. MIL-STD-780, "MAINTENANCE ENGINEERING ANALYSIS CONTROL NUMBER (MEACNS) FOR AERONAUTICAL EQUIPMENT, UNIFORM NUMBERING SYSTEM 21. MIL-STD-781, "RELIABILITY DESIGN QUALIFICATION AND PRODUCTION ACCEPTANCE TESTS: EXPONENTIAL DISTRIBUTION 22. MIL-STD-785B, "RELIABILITY PROGRAM FOR SYSTEMS AND EQUIPMENT DEVELOPMENT & PRODUCTION" 23. MIL-STD-810, "ENVIRONMENTAL TEST METHODS & ENGINEERING GUIDELINES" 24. MIL-STD-881, "WORK BREAKDOWN STRUCTURES FOR DEFENSE MATERIEL ITEMS 25. MIL-STD-882, "SYSTEM SAFETY PROGRAM REQUIRMENTS" 26. MIL-STD-965, "PARTS CONTROL PROGRAM" 27. MIL-STD-1369A, "INTEGRATED LOGISTIC SUPPORT PROGRAM REQUIREMENTS" 28. MIL-STD-1388-1A, "LOGISTICS SUPPORT ANALYSIS" 29. MIL-STD-1388-2A, "LOGISTICS SUPPORT ANALYSIS RECORD"

Name	Label	Description
		30. MIL-STD-1629, "PROCEDURES FOR PERFORMING A FAILURE MODE, EFFECTS & CRITICALITY ANALYSIS" 31. MIL-HDBK-472, "MAINTAINABILITY PREDICTION" 32. MIL-M-24100B, "FUNCTIONALY ORIENTED MAINTENANCE MANUALS (FOMM) FOR EQUIPMENT & SYSTEMS"
PM/DF	PROGRAM MANAGER FILE	
REQ/F	REQMNTS DOCUMNT FILE	REQUIREMENTS (DOCUMENTS) FILE ACRONYMS : JSOR - Joint Services Operational Requirements O&O - Operational and Organizational ROC - Required Operational Capabilities PURPOSE OF DATA STORE : This data store contains information on the stated RSI requirements which the system must or should meet. SOURCE OF DATA : Requirements documents (JSOR's, ROC's, multinational development agreements), O&O plans, Mission Profile documents, and systems or equipment specifications.

	Name	Label	Description
	PM/ILSMT	PM/ILSMT INITIATE REQMT	This external entity is the directive, authority, or other documentation that initiates the requirement for the application of this LSA. To the specific system/equipment development program at a specified point in it's life cycle in accordance with AR 700-127.

ANNEX C

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LSA TASK 303
EVALUATION OF ALTERNATIVES & TRADE-OFF ANALYSIS

SUBTASK 303.2.3 - SYSTEM TRADE-OFFS

ANNEX C
LSA SUBTASK - 303.2.3

PROCESS 303.2.3.1 - Consolidated Data For Use in Trade-off Analysis

PURPOSE:

To collect, sort and select data from state-of-the-art technology, industry predictions/forecasts, baseline configurations, Qualitative Materiel Requirements (QMRs) and Required Operational Capabilities (ROCs) Documents that will be needed in the accomplishment of any trade-off analysis related to the performance, reliability, maintainability, operational capability, survivability, serviceability, mission requirements, sustainability, producibility, and cost of the system/equipment being analyzed.

REFERENCES:

Listed in each Process.

PROCESS 303.2.3.1A1 - Industry Predictions and Forecasts

PURPOSE:

To obtain, from the industry involved in research, development and production of similar system/equipments, technological advances, design concepts, predictions and forecasts that would be applicable to the specific trade-off analysis.

PROCEDURES:

1. Enter the manufacturer/laboratory that provides a system being considered for inclusion in the trade-off analysis.

2. Describe this manufacturer's/laboratory's capability to meet mission requirements.

3. Record the estimated total program cost from the capability of this manufacturer/laboratory to meet mission requirements.

4. Enter any remarks pertaining to this system/equipment concerning the manufacturer/laboratory.

Industry Predictions & Forecasts
(303.2.3.1A1)

End Item Name:

Nomenclature:

Part Number:

1. Identify system/equipment surveyed:

2. Identify the manufacturer/laboratory surveyed:

3.
(1) Mission capability data:

(2) Cost

4. Remarks:

5. From an Industry Survey, Industry Briefings, reviews of industry technology, parametric design studies and industry prepared proposals, extract data that would be applicable to any trade-off analysis. However, the first step in identifying such data consists of identifying the subsystems, their significant performance, reliability, maintainability, and cost elements, and determining the manner in which the subsystem elements interact with each other.

6. Close coordination in the collection of this data must be made with the Combat Development Command to insure that future state-of-the-art developments are compatible with mission requirements.

REFERENCES:

1. Industry survey
2. Industry proposals
3. Parametric design studies

PROCESS 303.2.3.1A2 - List Qualitative Materiel Requirements (QMR) and Required Operational Capabilities (ROC) Attributes

PURPOSE:

To list performance, reliability, availability, maintainability, operational capability, survivability, serviceability, mission requirements, sustainability, producibility and cost attributes applicable to any possible trade-off analysis.

PROCEDURES:

1. The attributes derived from the system functional requirements and listed in the QMR and ROC Documents represent the upper and lower bounds for variable and fixed (constant) attributes. Use the attributes as input for trade-off analysis. Listed in the network or matrix, these attributes represent required limits, minimum and/or maximum values.

2. The attributes obtained from the QMR and ROC relate to the mission requirements, system/equipment performance, system/equipment reliability, maintainability, survivability and total system cost.

Qualitative Materiel Requirements Worksheet
(33.2.3.1A2)

End Item Name:

Nomenclature:

Part Number:

1. Identify System/Equipment:

2. Performance Required:

3. Reliability Required:

4. Availability Required:

5. Maintainability Required:

6. Operational (Mission) Capability:

7. Survivability Required:

8. Sustainability Required:

9. Supportability Required:

3. On the Qualitative Material Requirements Worksheet:

A. List the Performance attributes that are required for the system/equipment identified. These attributes may vary from system to system, or from trade-off to trade-off. Examples of Performance attributes are:

(1) Range requirements
(2) Maximum speed
(3) Minimum turnaround radius
(4) Etc.

B. Enter the reliability parameters that relate to the quantitative and qualitative values in the QMR and ROC.

C. Describe the operational availability as contained in the QMR and ROC.

D. Describe the quantitative and qualitative maintainability values from the QMR and ROC.

E. Describe the quantitative and qualitative values of operational (mission capability) from the QMR and ROC.

F. Describe the quantitative and qualitative survivability characteristics of the system from the QMR and ROC.

G. Describe the quantitative and qualitative sustainability characteristics of the system from the QMR and ROC.

H. Describe the quantitative and qualitative supportability characteristics of the system from the QMR and ROC.

REFERENCES:

1. Applicable Qualitative Materiel Requirement (QMR) Document
2. Applicable Required Operational Capabilities (ROC) Document

PROCESS 303.2.3.1A3 - Identify Attributes Applicable to Trade-off Analysis

PURPOSE:

To sort attributes obtained from Industry predictions, forecasts, proposals, and military requirements documents, by selecting those attributes required in any trade-off analysis.

PROCEDURES:

1. From the Program Management Office, obtain:

   a. Threat Analysis data applicable to any trade-off analysis.
   b. Applicable Readiness Objectives data.
   c. Applicable functional requirements data.
   d. Applicable projected cost data for development, production, logistic support and fielding of the competitive system/equipment that was prepared as part of the acquisition initiative, justification and planning prior to the assignment of a PM.

2. From the ILS, Engineering, or Analysis disciplines obtain:

   a. Maintenance and reliability experience of similar (Baseline) items if applicable to the trade-off analysis.
   b. LSA Task Cost Requirements if cost is a factor in the trade-off analysis.
   c. Cost Estimating Relationships applicable to any trade-off analysis.

3. From Subtask 301.2.2, obtain those functional requirements unique to the system/equipment due to new design technology or operational concept that are applicable to any trade-off analysis.

4. From the LSA Subtask 301.2.1, select those functions of the system/equipment alternatives that are going to be subjected to the trade-off analysis. Selected functions should be only those that are affected by changes in the variables used in the trade-off analysis and are contained in the network/matrix of system/equipment performance criteria developed in Processes 303.2.3.1A1 and 303.2.3.1A2.

   NOTE: Consider peacetime and wartime system functional requirement separately if different requirements exist.

5. Record on the applicable attribute worksheet, the quantitative attributes that specify the selected operating functions of the system/equipment under consideration.

6. For comparison purposes, enter the QMR/ROC requirement associated with each attribute of the selected functions.

TABLE 1. SAMPLE WORKSHEET FOR IDENTIFICATION OF ATTRIBUTES

Attributes/ Sub-attributes	Required QMR/ROC	System/Equipmt. Alternatives ALT 1	ALT 2	ALT 3
1. Performance:				
a. Range		1500 Mi.	1400 Mi.	1600 Mi.
b. Max. Speed		800 MPH	800 MPH	800 MPH
c. Payload		15 Tons	16 Tons	14 Tons
2. Reliability:				
3. Availability:				

Note: The above example should be used in listing data for for the remaining main attributes.

Applicable Attributes Worksheet
(303.2.3.1A3)
Peacetime

End Item Name:

Nomenclature:

Part Number:

Attributes & Sub-attributes	Required	System/Equipment Alternatives			
	QMR/ROC	Alt. 1	Alt. 2	Alt. 3	Alt. 4
1. Performance a. b. c.					
2. Reliability a. b.					
3. Availability a. b.					
4. Maintainability a. b. c.					
5. Operational (Mission) Capability					
6. Survivability					
7 Sustainability					
8. Supportability					
9. Cost	N/A				

Remarks:

Applicable Attributes Worksheet
(303.2.3.1A3)
Wartime

End Item Name:

Nomenclature

Part Number:

Attributes & Sub-attributes	Required	System/Equipment Alternatives			
	QMR/ROC	Alt. 1	Alt. 2	Alt. 3	Alt. 4
1. Performance a. b. c.					
2. Reliability a. b.					
3. Availability a. b.					
4. Maintainability a. b. c.					
5. Operational (Mission) Capability					
6. Survivability					
7. Sustainability					
8. Supportability					
9. Cost	N/A				

Remarks:

7. The result of the above procedure is a network/matrix of attributes for the Baseline and system/equipment alternative designs applicable to any trade-off analysis. With data collected in Process 303.2.3.1, any future trade-off analysis can be performed by selecting attributes from the network/matrix.

NOTE: This is a dual purpose worksheet. One worksheet is for peacetime data; the second worksheet is for wartime data. This information may be obtained from the Program Manager's Office.

PROCESS 303.2.3.2 - Establish and Define Attributes

PURPOSE:

This process identifies and defines baseline, variable and fixed (constant) attributes that will be used in any trade-off analysis on the system/equipment design alternatives.

PROCESS 303.2.3.2A1 - Determine and Define "Baseline" Attributes

PURPOSE:

Identifies the attributes (parameters) of a standard "Baseline" design which approximates the performance, maintainability, and survivability characteristics specified in the QMR/ROC Documents.

PROCEDURE:

1. The analyst must select a fielded system/equipment similar in design and performance to the system/equipment alternative designs and with the assistance of a system engineer, list the systems attributes on the "Baseline" Attributes Determination Worksheet as described in Processes 303.2.3.1A1 and 303.2.3.1A2. This list will contain all known attributes that will be used in any trade-off analysis on the system/equipment alternatives. Include the estimated total cost in this listing.

2. The "Baseline" attributes (parameters) will be used, in comparative analysis and trade-offs, for comparing "Baseline" attributes with alternative system/equipment attributes.

"Baseline" Attributes Determination Worksheet
(303.2.3.2A1)

End Item Name:

Nomenclature:

Part Number:

1. Baseline System/Equipment:

2. Performance:

3. Reliability:

4. Availability:

5. Maintainability:

6. Operational (Mission) Capability:

7. Survivability Required:

8. Sustainability Required:

9. Supportability Required:

3. If no state-of-the-art Baseline configuration exists, the attributes in the QMR/ROC could be used as a "Baseline". However, this imposes a problem in program costing when comparing state-of-the-art attributes with the forecasted military requirements.

REFERENCES:

1. Results of LSA Task 203. The task results contain a historical record of operational maintenance and support functions of items/equipment that can be used as a "Baseline" to forecast or predict the functional requirements and/or characteristics of the development system/equipment. However, to get detail attributes that could be used in the analysis, a review of the applicable model specification, QMR/ROC is necessary.

2. Historical Data on Design Influence (HIS/DESG). This is a historical record of studies performed on "Baseline" system equipments and will have certain attributes listed. If this file does not contain the attribute information needed, the analyst, with the assistance of the system engineer, must go to the model specification for the specific system to obtain the required attributes.

PROCESS 303.2.3.2A2 - Determine and Define Variable Attributes

PURPOSE:

Select performance, reliability, maintainability, operational capability, survivability, producibility and cost attributes that will vary in any system/equipment trade-off analysis.

PROCEDURE:

1. List the variable attributes to be used on any trade-off analysis on the "Trade-Off Analysis Attribute Worksheet". This worksheet can be used as a guidance chart to select the applicable variables for a specific trade-off analysis.

NOTE: Trade-offs are quantitative measures of changes in performance or program parameters; as the term implies, an improvement in one respect is usually accompanied by a degradation in another. In a more general sense, trade-offs represent the relationships between changes in one performance/program attribute and the corresponding change in others.

Two examples are:

a. Weight and cost as a function of reliability.

b. Reliability and maintainability as a function of availability. Therefore, the first step is the determination of which attributes will change as a result of a change in one or more attributes.

2. Establish commonality to determine which attributes to hold constant and those which will vary.

3. Use the results of preliminary/parametric design studies to select independent and dependent variables for analysis. The studies may also be used to understand the relationships between variables.

4. The Analyst, with assistance from a system engineer, must prepare a list of constant and variable attributes for the specific trade-off analysis. As an example, a typical list for a trade-off analysis for the effect of endurance and payload with a change in speed could be:

a. Constant Attributes:

(1) Crew size
(2) Installed power
(3) Sea state limitations

b. Variable attributes:

(1) Speed
(2) Endurance
(3) Survivability

REFERENCES:

1. Process 303.2.3.1, Consolidate Data for Use in Trade-off Analysis.
2. HIS/FUNC will provide attributes related to maintenance and support functions.

PROCESS 303.2.3.2A3 - Determine and Define Constant Attributes

PURPOSE:

Select performance, reliability, maintainability, operational capability, survivability, producibility and cost attributes that will remain constant in the specific trade-off analysis being performed.

PROCEDURE:

1. Follow the procedures from Process 303.2.3.2A2 to obtain constant attributes.

2. The determination of which attributes are to be constant depends on the type of trade-off analysis being performed.

REFERENCES:

See references for Process 303.2.3.2A2

PROCESS 303.2.3.2A4 - Attributes Applicable to Trade-off Analysis

PURPOSE:

To consolidate all applicable "Baseline", variable and constant attributes and their associated formulas for variations into one data source applicable only to the specific trade-off analysis being performed and identified by Process 303.2.3.2.

PROCEDURE:

This procedure involves the collection of data only applicable to the specific trade-off analysis being performed. This data must also include the requirements of the QMR/ROC.

REFERENCES:

1. DA Organization Information Data Base (D/A)
2. Processes 303.2.3.2A1, 303.2.3.2A2 and 303.2.3.2A3.

Trade-Off Analysis Attribute Worksheet
(303.2.3.2A4)
Peacetime

End Item Name:

Nomenclature:

Part Number:

Attributes & Sub-attributes	Baseline		Required QMR/ROC		System/Equipment Alternatives			
					Alt. 1		Alt. 2	
	Constant	Variable	Constant	Variable	Constant	Variable	Constant	Variable
1. Performance a. b.								
2. Reliability a. b.								
3. Availability a. b.								
4. Maintainability								
5. Operational (Mission) Capability								
6. Survivability								
7. Sustainability								
8. Supportability								
9. Cost			N/A	N/A				

REMARKS:

Trade-Off Analysis Attribute Worksheet
(303.2.3.2A4)
Wartime

End Item Name::

Nomenclature:

Part Number:

Attributes & Sub-attributes	Baseline		Required QMR/ROC		System/Equipment Alternatives			
	Constant	Variable	Constant	Variable	Alt. Constant	1 Variable	Alt. Constant	2 Variable
1. Performance a. b.								
2. Reliability a. b.								
3. Availability a. b.								
4. Maintainability								
5. Operational (Mission) Capability								
6. Survivability								
7. Sustainability								
8. Supportability								
9. Cost								

Remarks:

PROCESS 303.2.3.3 - Perform Preliminary Analysis of Technology

PURPOSE:

To perform preliminary/parametric analysis of each alternative system/equipment by varying selected attributes to determine the effect/changes in related attributes.

PROCEDURE:

1. Preliminary design studies, necessary to support the system/ equipment trade-off analysis, must be obtained from the Program Manager's Office. Review this work and extract information such as the technical descriptions, payload, range, speed, firepower, etc., for the system/equipment alternatives.

2. Define appropriate trade-off criteria such as minimum cost, schedule, performance, etc. This criteria/data will come from Task 301 which identifies the operations and support functions that must be performed for each system/equipment alternative under consideration.

3. Define the level of detail (hardware indenture level) to be applied to the preliminary/ parametric analysis to determine the relationships and effects of the attributes under analysis.

4. Establish the attributes of a standard "Baseline" design that meets the military requirements of the system/ equipment alternatives. This establishes a starting point for all attributes of interest for preliminary analysis.

5. Determine the risk levels associated with any new technology incorporated into the system design. LSA Subtask 301.2.3, "Risk Analysis" provides an analysis of the risk associated with new technology to satisfy the functional requirements. From these results, select the appropriate variable parameters needed to perform the trade-off analysis and any required sensitivity analysis.

REFERENCES:

1 Subtask 301.2.1, Functional Requirements
2. Subtask 301.2.2, Unique Functional Requirements
3. Subtask 301.2.3, Risks (associated with attribute changes of each system/equipment alternative under consideration).
4. Subtask 301.2.4, Operations and Maintenance Tasks
5. Subtask 301.2.5, Design Alternatives

PROCESS 303.2.3.4 - Identify Cost Formula

PURPOSE:

To develop a cost formula that will be used in determining total program cost for each system/equipment alternative under consideration.

PROCESS 303.2.3.4A1 - Identify and List Cost Inputs

PURPOSE:

To provide cost inputs that will provide the best balance between schedule, performance, logistics, readiness and support.

PROCEDURE:

1. From the Program Manager's Office, obtain Industry Surveys and proposals, and the cost data for system/equipment alternative designs. The analyst must find the cost of operating, developing and supporting the system/equipment alternative designs under consideration.

2. The analyst, with the assistance of a cost analyst, must select the "high drivers" from Process 303.2.3.3 "Preliminary Analysis of Technology" that have a large affect on the cost of operating, developing and supporting the system/equipment alternative under consideration.

3. Attributes listed in Process 303.2.3.2, "Establish and Define Attributes" must be selected and used in Process 303.2.3.3 "Preliminary Analysis of Technology" for use as potential cost drivers.

4. The analyst must review cost models in AMC-P700-4 for models applicable to the trade-off analysis. If there are no applicable models, further research into the cost provided by the Industry Survey and/or Industry Proposals must be investigated and an applicable model developed.

REFERENCES:

1. Process 303.2.3.2, Establish and Define Attributes
2. Process 303.2.3.3, Preliminary Analysis of Technology
3. Process 303.2.3.5, Establish Level of Effort
4. AMC-P-700-4
5. Industry Survey

PROCESS 303.2.3.4A2 - Identify Unique Cost Drivers

PURPOSE:

To determine unique cost drivers to be used in specific tradeoff analysis.

PROCEDURE:

1. The Analyst, with the assistance of a system engineer, must determine those attributes that, when changed, will have the largest affect on development, operations, readiness and support cost for the system/equipment alternative under consideration.

2. Unique cost factors to consider during Concept Formulation are: design, testing, evaluations, documentation of program management, engineering and support for the entire life cycle of the system equipment under consideration.

3. Likewise, unique cost factors during production and/or fielding must include cost of production, logistics, maintenance, fielding and training as applicable to the particular trade-off analysis. This must be determined by the Analyst in his initial planning for performing the trade-off analysis.

REFERENCES:

1. Program Manager's Office
2. Development Program Data Baseline File
3. Historical Data File
4. Industry Survey and/or Proposals.

PROCESS 303.2.3.5 - Establish Level of Effort

PURPOSE:

To determine the level of effort to be used in the trade-off process.

PROCEDURE:

1. The Analyst must determine the level of effort that can be applied to the trade-off analysis based on the availability of firm/estimated data and the accuracy of such data. The level of effort during concept formulation will be at a much lower or less detailed level than it would be during production or fielding stage of the system/equipment alternatives under consideration.

2. Trade-offs during concept formulation and development will require reliable estimates for certain attributes. When such estimates are made by the Analyst, a statement as to the confidence and risk must be made. In certain cases, a risk analysis may be required to justify the estimate.

REFERENCES:

1. Process 303.2.3.2, Establish and Define Attributes.
2. Process 303.2.3.3, Preliminary Analysis of Technology
3. Process 303.2.3.4, Identify Cost Formula

PROCESS 303.2.3.6 - Conduct Trade-off Analysis

PURPOSE:

Using the data collected in Process 303.2.3.1, the attributes established and defined in Process 303.2.3.2, the results of the preliminary analysis of technology Process 303.2.3.3, cost determined in Process 303.2.3.4 and the level of effort determined in Process 303.2.3.5, perform the trade-off analysis.

PROCESS 303.2.3.6A1 - Define Method of Evaluation and Models Used

PURPOSE:

To construct analytical relationships used in comparing attributes for the system/equipment alternatives and determine from these relationships whether a model can be used for performing the analysis.

PROCEDURE:

1. Determine the analytical relationships that will be used in the trade-off analysis and review AMC-P700-4 or equivalent for applicable models.

2. If no model can be found applicable to the specific attribute relationships, generate a model by answering the following questions associated with the basic processes. The analyst must be prepared to work with a host of different models which respond to these questions:

a. Define the Model Objectives:

(1) What is the problem?
(2) What must be accomplished?

(3) Who is the decision maker?
(4) What is his value system?
(5) How will he pick among alternatives
(6) What are the constraints?

b. Generating manual alternatives:

(1) What are the manual alternatives?
(2) How will these alternatives operate under the conditions (constraints) of the problem?
(3) How much do they cost?
(4) What will they produce?

c. Evaluating Alternatives:

(1) What alternative do I pick?
(2) What factors affect the worth of each alternative?

REFERENCES:

1. AMC-P700-4 or equivalent for existing applicable models.
2. Process 303.2.3.2 for applicable attributes.

PROCESS 303.2.3.6A2 - Select Applicable "Baseline" Attributes

PURPOSE:

To determine "Baseline" attributes that can be compared with similar system/equipment attributes for the preparation of a comparative analysis if required as part of the trade-off analysis.

PROCEDURE:

1. Select from Process 303.2.3.2A1, the "Baseline" attributes to be used in the trade-off analysis.

2. If the analyst elects to do a comparative evaluation trade-off of the system/equipment attributes instead of a finite evaluation trade-off, the attributes selected as "Baseline" would be identified at a value of 1.0 and attributes from the system/equipment alternatives would then be rated as 1+ or 1-, based on their comparative value to the "Baseline" attributes.

REFERENCES:

1. Historical File of Functions (HIS/FUNC).
2. Historical Data on Design Influence (HIS/DESG).
3. Process 303.2.3.2A1, Determine and Define "Baseline" Attributes.

PROCESS 303.2.3.6A3 - Select Applicable Variable Attributes

PURPOSE:

To select the applicable variable attributes to be used in the trade-off analysis. This is part of the Essential Elements of Analysis (EEA) as discussed in Process 303.2.3.6A5.

PROCEDURE:

1. Using the method of evaluation from Process 303.2.3.6A1, select the variable attributes from the Applicable Attribute Worksheet for analysis. The relationship between the variables can be obtained from the results of Process 303.2.3.2A2, "Determine and Define Variable Attributes".

2. From the Trade-Off Analysis Attribute Worksheet, select the values of the variable attributes to be used as model input.

REFERENCES:

1. Process 303.2.3.1, Consolidate Data for Use in Trade-off Analysis
2. Process 303.2.3.2, Establish and Define Attributes
3. Process 303.2.3.3, Preliminary Analysis of Technology

PROCESS 303.2.3.6A4 - Select Applicable Fixed Attributes

PURPOSE:

To select the applicable fixed (constant) attributes to be used in the trade-off analysis. This is a part of the Essential Elements of Analysis (EEA) as discussed in Process 303.2.3.6A5.

PROCEDURE:

1. Using the method of evaluation from Process 303.2.3.6A1, select those attributes which will remain fixed or constant from

the Applicable Attributes Worksheet. These attributes are essentially independent of each other and the other variable attributes.

2. From the Trade-Off Analysis Attribute Worksheet, select the constant attribute values and use them as model input.

NOTE: Such fixed attributes allow for a better and more realistic comparison of attributes that are varied and therefore provide a more practical procedure for optimization.

REFERENCES:

1. Process 303.2.3.1, Consolidate Data for Use in Trade-off Analysis.
2. Process 303.2.3.2, Establish and Define Attributes
3. Process 303.2.3.3, Preliminary Analysis of Technology

PROCESS 303.2.3.6A5 - Conduct Sensitivity Analysis

PURPOSE:

To determine the sensitivity of the variable attributes as they affect performance, design, reliability, maintainability, supportability and cost.

PROCEDURE:

1. The Analyst must select the Essential Element of Analysis (EEA) for the specific sensitivity analysis. EEA selection criteria are:

a. Attributes based on estimates.
b. Attributes taken from a Baseline system.
c. Known cost, schedule or support driven attributes.
d. Attributes identified as high risk due to technology or resource constraints.

2. Select an EEA to be varied.

3. Determine the range of values over which the EEA should be varied (e.g., minimum value, one-half to one-third the original value, maximum value, double or triple value).

4. Hold all other variables constant, using the mathematical model to determine the effect of varying the EEA on the other attributes of the system.

5. Determine how the performance, design, reliability, maintainability, supportability and cost are affected over the range of values for the EEA.

6. Repeat steps 1-5 for all attributes that were selected as EEAs.

7. Identify those EEAs that significantly impact the other attributes as potential problem areas and make them a consideration in the final trade-off analysis decision.

REFERENCES:

1. Process 303.2.3.6A2, Select Applicable "Baseline" Attributes
2. Process 303.2.3.6A3, Select Applicable Variable Attributes
3. Process 303.2.3.6A4, Select Applicable Fixed Attributes

PROCESS 303.2.3.6A6 - Determine Risk Level

PURPOSE:

To assess the risk level in each variable attribute as well as the risk of estimating or predicting values not available in the system/equipment data.

PROCEDURE:

1. For each variable attribute that is part of the trade-off analysis, determine the associated level of risk.

2. Assign probabilities (as percentages) that represent the likelihood of the particular value being attained by the system when it becomes operational.

3. There are two types of risk level determination. The first deals with the probability of achieving a technological breakthrough or meeting cost and schedule goals. The second concerns the accuracy of an estimated number or quantity, such as logistics delay times or cost of spare parts.

For example, the type of risk analysis that can be used could possibly result in risk levels identified as follows:

a. In a typical program, 10% of the activity might be such that it can only be estimated within a 50% risk level.

b. or, 30% of the activity might be such that it can only be estimated within 6 or 7%

c. The effective uncertainty or risk for these examples then is from 10 to 15%, depending on the affect various attributes have on the other attributes.

REFERENCES:

1. Process 303.2.3.1
2. Process 303.2.3.2
3. Process 303.2.3.3

PROCESS 303.2.3.6A7 - Conduct Trade-off Analysis

PURPOSE:

Using the selected attributes, results of the preliminary and parametric analysis, information developed on sensitivity levels of attributes as they are varied, the risk level established or predicted, and the calculated/predicted total program cost, conduct the specific trade-off analysis using only the factors listed above that are needed in the analysis.

PROCEDURE:

1. Develop curves or graphs for variable attributes as required from data developed in Process 303.2.3.2A4 for the system/equipment alternatives being analyzed.

2. With this data, define the optimum system/equipment.

NOTE: Optimization is not the selection of the best possible alternative. It is, however, the selection of the best alternative from a given set of attributes using the Analyst's criteria of selection.

3. The trade-off analysis, in most cases, should first be made solely on the basis of the fixed and variable applicable attributes specified, and then the cost factors should be included.

4. After completing the above, the Analyst must weigh in terms of risk, each system/equipment, and then weigh each in terms of their optimized trade-off characteristics. The results should be a series of system/equipment configurations optimized in terms of maximum performance, reliability, maintainability, logistic support, etc.

PROCESS 303.2.3.7 - Document Results

PURPOSE:

Prepare a report describing the results of the trade-off analysis with recommendations and conclusions.

PROCEDURE:

1. Document, in narrative format, the results of the trade-off analysis showing the optimum system/equipment alternative or values if the trade-off analysis results in a refinement in design, configuration, schedule, cost, etc..

2. The final report or document must contain recommendations and conclusions obtained from the trade-off analysis and the extent of the change in design, schedule cost, etc., required for each combination of conditions. Any recommended changes to the military requirements that could result from the trade-off analysis must also be included.

3. Every effort must be made to make the resulting trade-off analysis report as concise and specific as the information available permits. State the rationale for acceptance of the system/equipment alternative. Summarize the important characteristics of each acceptable system/equipment alternative and present this information to the Program Manager. If necessary, a comparative analysis of the composite effectiveness of each system/equipment alternative must be made with a sensitivity analysis.

Document Results
(303.2.3.7)

End Item Name:

Nomenclature:

Part Number:

1. Analysis of Technology:

2. Cost Formula:

3. Level of Effort:

4. Tradeoff Analysis:

5. Justification:

ANNEX D

—

VERT BATCH INPUT FILES FOR LSA SUBTASK 303.2.3

VERT APPLICATION METHODOLOGY

BACKGROUND:

Venture Evaluation and Review Technique (**VERT**) was developed as a network analysis technique to facilitate management decision making. It allows a systematic planning and control of programs and enables managers to find solutions to real life managerial problems.

The terms of the APJ contract require the provision of batch files for each of the VERT networks associated with the various Data Flow Diagrams in the APJ 966 projects.

APJ has been successful in adopting a method for the creation of these networks using the existing EXCELERATOR software package and establishing a naming convention compatible with that used in the Data Flow Diagrams. To do this APJ has made use of the PC model of VERT. A Structured Analysis project was used for this purpose. The prototype VERT network structure was made for one top level and one lower level data flow diagram.

The PC model of VERT has certain limitations built into it. To overcome some of these limitations, certain conventions were used to create the input files. To maintain full generality a set of "dummy" default values were established. The model allows the user to alter the default values of time, cost, and performance to satisfy their specific requirements.

METHODOLOGY:

The basic symbols used to structure the network are :

(i) **SQUARES** - to indicate NODES. These are decision points in the project, or points beyond which the project cannot proceed unless certain criteria are met. There are two types of nodes, one which supports input operations and, the second type which supports output operations.

(ii) **LINES** - to indicate ARCS which are activities that have time, cost, and performance criteria associated with them.

In practice, however, both the arcs and nodes are similar, in that both have time, cost, and performance criteria associated with them. The arcs have a primary and a cumulative set of time, cost, and performance criteria whereas the nodes have only a single cumulative set.

(iii) **NAMING CONVENTIONS** - Efforts have been made to keep the naming convention as compatible as possible to the Data Flow Diagrams. The naming convention used is displayed below.

NODES - All nodes are prefixed with the letter **N**. The individual Nodes are identified by a number and a letter. The number refers to the number of the node within the diagram and the letter refers to the diagram number in the project. In the event that a node has been referenced in an earlier diagram they also carry the number of the node in the earlier diagram as a prefix to the individual node number.

N2.4A

N - All nodes are prefixed with the letter **N**

2 - Gives the number of the node it relates to in a higher level diagram or an earlier data flow diagram within the project. In this case it refers to node **N2** of the top level diagram.

4 - Gives the number of the node in the present data flow diagram.

A - The nodes in each subsequent explosion are allotted an alphabetical suffix indicating the number of the explosion diagram in the particular project. In this case, it is the first lower level diagram within the project.

ARCS - All arcs are prefixed with either the letter **C** or **E**. The individual Arcs are identified by two numbers. The first number refers to the number of the arc within the diagram and the second number refers to the number of the diagram within the project. In the event that an arc has been referenced in an earlier diagram they also carry the number of the arc in the earlier diagram as a prefix to the individual arc number. The arcs which are identified by the letter **E** have direct reference to a process in the corresponding data flow diagram and as such are named the same as the process itself.

C3.3.8.4 **E12.1A2**

C - All arcs are prefixed with the letter C. In some cases, however, arcs carry a prefix of **E**. These particular arcs correspond to a process within the data flow diagram and are thus named the same as the process itself.

3.3 - Gives the number of the arc it relates to in a higher level diagram or an earlier data flow diagram within the project. In this case, it refers to arc number 3 in lower level diagram #3 within the project.

8.4 - Indicates that this particular arc is the #8 arc in the #4 lower level diagram of the project.

BATCH FILES

INPUT FILES - The input file names are given the extension *.**IN**.

OUTPUT FILES - The simulation output files are given the extension *.**OU**.

PRINT FILES - The print files have been given the extension *.**PR**.

(This would allow subsequent updates of the input files to be numbered as **IN1**...,**OU1**...,**PR1**... etc.)

DEFAULT SETTINGS:

Control Record:

(i) The output option selected is "0" which provides a detailed listing, and high level of summary information.

(ii) The input record listing option selected is "0" which prints all input records.

(iii) The composite terminal node output option selected is "16" which assumes family mode and intrafamily transfer of histogram data.

(iv) The number of iterations used are "10" in the demonstration model to facilitate operation in the debug mode if required.

(v) The composite node name and the network name are left as blanks.

(vi) In the run identification the name of the corresponding Data Flow Diagram is used as identification for the network description.

Arc Records:

(i) For each of the arcs the following records are provided:
   (a) Master Arc Record
   (b) Time Distribution Satellite
   (c) Cost Distribution Satellite
   (d) Performance Distribution Satellite

(ii) The Distribution Satellite Records are created to provide a uniform statistical distribution.

(iii) The default values used for the minimum and maximum in each criteria are:

TIME	10.0	20.0
COST	10.0	100.0
PERFORMANCE	10.0	50.0

Node Records:

(i) Input Logic - The input logic for the nodes are either **"INITIAL" or "AND".**

(ii) Output Logic - The output logic has been defaulted to **"AND" or "TERMINAL".**

(iii) The output option indicator and the storage option indicator are defaulted to read "0".

(iv) The node description has also been left blank.

(It is again noted that the user can change the default values to desired values as identified by the particular requirement and applications.)

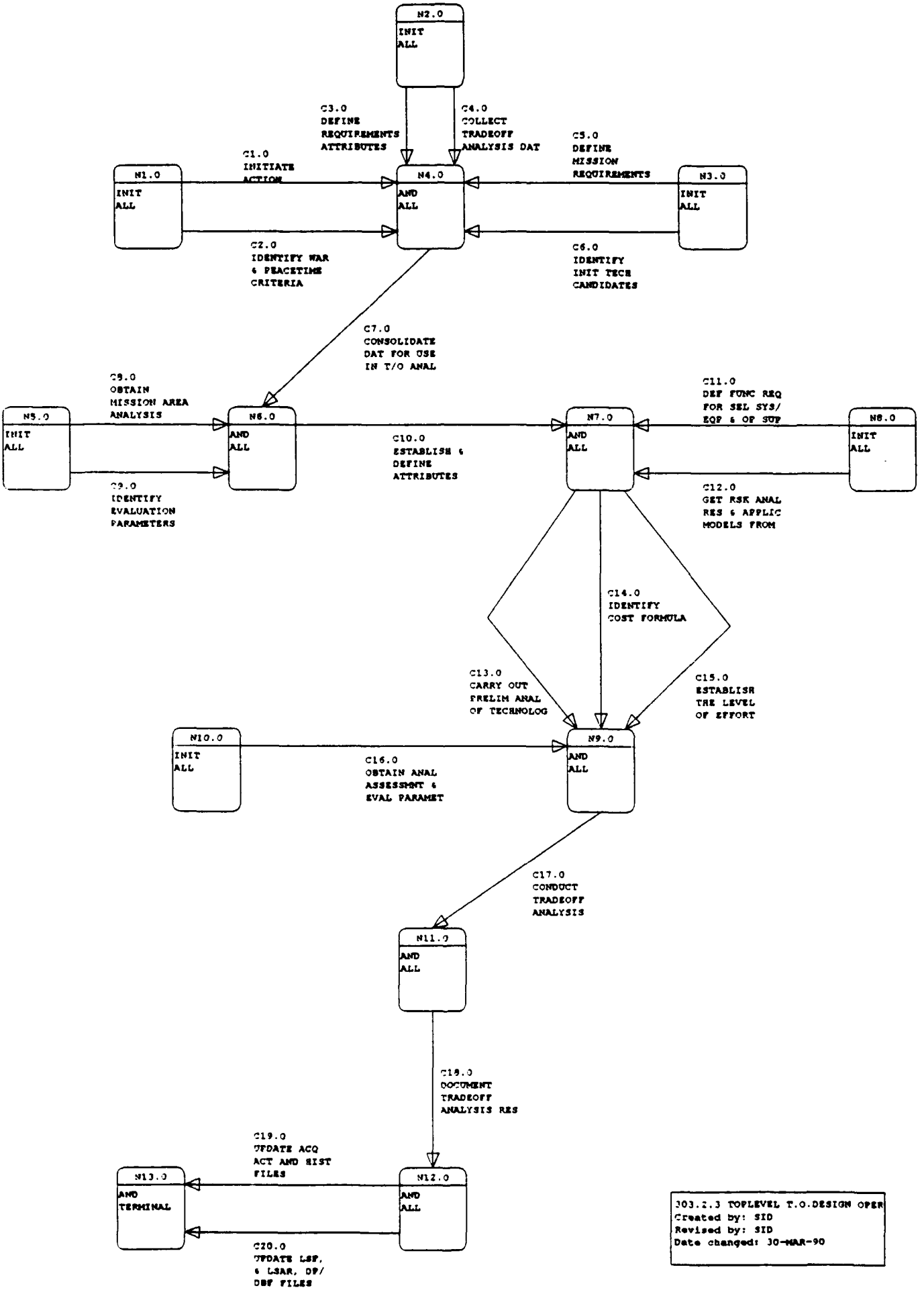
DOCUMENTATION:

With every project report APJ will be providing the following documents relating to the VERT:

(i) A VERT network diagram corresponding to a particular data flow diagram.

(ii) A print out of the VERT network inputs for the particular data flow diagrams.

(iii) A floppy disc containing sample input, print, and the simulation output files for the default VERT network.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ALL
C3.0
DEFINE
REQUIREMENTS
ATTRIBUTES
C4.0
COLLECT
TRADEOFF
ANALYSIS DAT
C5.0
DEFINE
MISSION
REQUIREMENTS
C1.0
INITIATE
ACTION
N1.0
INIT
ALL
N4.0
AND
ALL
N3.0
INIT
ALL
C2.0
IDENTIFY WAR
& PEACETIME
CRITERIA
C6.0
IDENTIFY
INIT TECH
CANDIDATES
C7.0
CONSOLIDATE
DAT FOR USE
IN T/O ANAL
C8.0
OBTAIN
MISSION AREA
ANALYSIS
C11.0
DEF FUNC REQ
FOR SEL SYS/
EQP & OP SUP
N5.0
INIT
ALL
N6.0
AND
ALL
N7.0
AND
ALL
N8.0
INIT
ALL
C10.0
ESTABLISH &
DEFINE
ATTRIBUTES
C9.0
IDENTIFY
EVALUATION
PARAMETERS
C12.0
GET RSK ANAL
RES & APPLIC
MODELS FROM
C14.0
IDENTIFY
COST FORMULA
C13.0
CARRY OUT
PRELIM ANAL
OF TECHNOLOG
C15.0
ESTABLISH
THE LEVEL
OF EFFORT
N10.0
INIT
ALL
N9.0
AND
ALL
C16.0
OBTAIN ANAL
ASSESSMNT &
EVAL PARAMET
C17.0
CONDUCT
TRADEOFF
ANALYSIS
N11.0
AND
ALL
C18.0
DOCUMENT
TRADEOFF
ANALYSIS RES
C19.0
UPDATE ACQ
ACT AND HIST
FILES
N13.0
AND
TERMINAL
N12.0
AND
ALL
C20.0
UPDATE LSF,
& LSAR, DF/
DBF FILES
303.2.3 TOPLEVEL T.O.DESIGN OPER
Created by: SID
Revised by: SID
Date changed: 30-MAR-90

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    1. 0016  10                TRADEOFF DESIGN OPERATIONS
                +         +         +         +         +         +         +         +
    2. C1.0     N1.0    N4.0      1.0 INITIATE ACTION
    3. C1.0     DTIME 1         2      10.0      20.0
    4. C1.0     DCOST 1         2      10.0     100.0
    5. C1.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
    6. C2.0     N1.0    N4.0      1.0 IDENTIFY WARTIME AND PEACETIME CRITERIA
    7. C2.0     DTIME 1         2      10.0      20.0
    8. C2.0     DCOST 1         2      10.0     100.0
    9. C2.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   10. C3.0     N2.0    N4.0      1.0 DEFINE REQUIREMENTS ATTRIBUTES
   11. C3.0     DTIME 1         2      10.0      20.0
   12. C3.0     DCOST 1         2      10.0     100.0
   13. C3.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   14. C4.0     N2.0    N4.0      1.0 COLLECT TRADEOFF ANALYSIS DATA
   15. C4.0     DTIME 1         2      10.0      20.0
   16. C4.0     DCOST 1         2      10.0     100.0
   17. C4.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   18. C5.0     N3.0    N4.0      1.0 DEFINE MISSION REQUIREMENTS
   19. C5.0     DTIME 1         2      10.0      20.0
   20. C5.0     DCOST 1         2      10.0     100.0
   21. C5.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   22. C6.0     N3.0    N4.0      1.0 IDENTIFY INITIAL TECHNICAL CANDIDATES
   23. C6.0     DTIME 1         2      10.0      20.0
   24. C6.0     DCOST 1         2      10.0     100.0
   25. C6.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   26. C7.0     N4.0    N6.0      1.0 CONSOLIDATE DATA FOR USE IN TRADEOFF ANALYSIS
   27. C7.0     DTIME 1         2      10.0      20.0
   28. C7.0     DCOST 1         2      10.0     100.0
   29. C7.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   30. C8.0     N5.0    N6.0      1.0 OBTAIN MISSION AREA ANALYSIS
   31. C8.0     DTIME 1         2      10.0      20.0
   32. C8.0     DCOST 1         2      10.0     100.0
   33. C8.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   34. C9.0     N5.0    N6.0      1.0 IDENTIFY EVALUATION PARAMETERS
   35. C9.0     DTIME 1         2      10.0      20.0
   36. C9.0     DCOST 1         2      10.0     100.0
   37. C9.0     DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   38. C10.0    N6.0    N7.0      1.0 ESTABLISH AND DEFINE ATTRIBUTES
   39. C10.0    DTIME 1         2      10.0      20.0
   40. C10.0    DCOST 1         2      10.0     100.0
   41. C10.0    DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
   42. C11.0    N8.0    N7.0      1.0 DEFINE FUNC REQ FOR SELECTED SYS/EQPT & OP SUPPORT
   43. C11.0    DTIME 1         2      10.0      20.0
   44. C11.0    DCOST 1         2      10.0     100.0
   45. C11.0    DPERF 1         2      10.0      50.0
                +         +         +         +         +         +         +         +
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46. C12.0   N8.0    N7.0     1.0 GET RISK ANAL RES & APPLIC MODELS FRM DA PAM 700-4
47. C12.0   DTIME 1         2      10.0      20.0
48. C12.0   DCOST 1         2      10.0     100.0
49. C12.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
50. C13.0   N7.0    N9.0     1.0 CARRY OUT PRELIMINARY ANALYSIS OF TECHNOLOGY
51. C13.0   DTIME 1         2      10.0      20.0
52. C13.0   DCOST 1         2      10.0     100.0
53. C13.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
54. C14.0   N7.0    N9.0     1.0 IDENTIFY COST FORMULA
55. C14.0   DTIME 1         2      10.0      20.0
56. C14.0   DCOST 1         2      10.0     100.0
57. C14.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
58. C15.0   N7.0    N9.0     1.0 ESTABLISH THE LEVEL OF EFFORT
59. C15.0   DTIME 1         2      10.0      20.0
60. C15.0   DCOST 1         2      10.0     100.0
61. C15.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
62. C16.0   N10.0   N9.0     1.0 OBTAIN ANALYSIS ASSESSMENT AND EVALUATION PARAMETER
63. C16.0   DTIME 1         2      10.0      20.0
64. C16.0   DCOST 1         2      10.0     100.0
65. C16.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
66. C17.0   N9.0    N11.0    1.0 CONDUCT TRADEOFF ANALYSIS
67. C17.0   DTIME 1         2      10.0      20.0
68. C17.0   DCOST 1         2      10.0     100.0
69. C17.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
70. C18.0   N11.0   N12.0    1.0 DOCUMENT TRADEOFF ANALYSIS RESULTS
71. C18.0   DTIME 1         2      10.0      20.0
72. C18.0   DCOST 1         2      10.0     100.0
73. C18.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
74. C19.0   N12.0   N13.0    1.0 UPDATE ACQUIRING ACTIVITY AND HISTORICAL FILES
75. C19.0   DTIME 1         2      10.0      20.0
76. C19.0   DCOST 1         2      10.0     100.0
77. C19.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
78. C20.0   N12.0   N13.0    1.0 UPDATE LSF, LSAR, DP/DBF FILES
79. C20.0   DTIME 1         2      10.0      20.0
80. C20.0   DCOST 1         2      10.0     100.0
81. C20.0   DPERF 1         2      10.0      50.0
             +         +         +         +         +         +         +         +
82. ENDARC
             +         +         +         +         +         +         +         +
83. N1.0    1  2 0 0
             +         +         +         +         +         +         +         +
84. N4.0    2  2 0 0
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85. N2.0    1  2 0 0
             +         +         +         +         +         +         +         +
86. N3.0    1  2 0 0
             +         +         +         +         +         +         +         +
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  88. N5.0    1  2 0 0
                +         +         +         +         +         +         +         +
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                +         +         +         +         +         +         +         +
  90. N8.0    1  2 0 0
                +         +         +         +         +         +         +         +
  91. N9.0    2  2 0 0
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  93. N11.0   2  2 0 0
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  94. N12.0   2  2 0 0
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  95. N13.0   2  1 0 0
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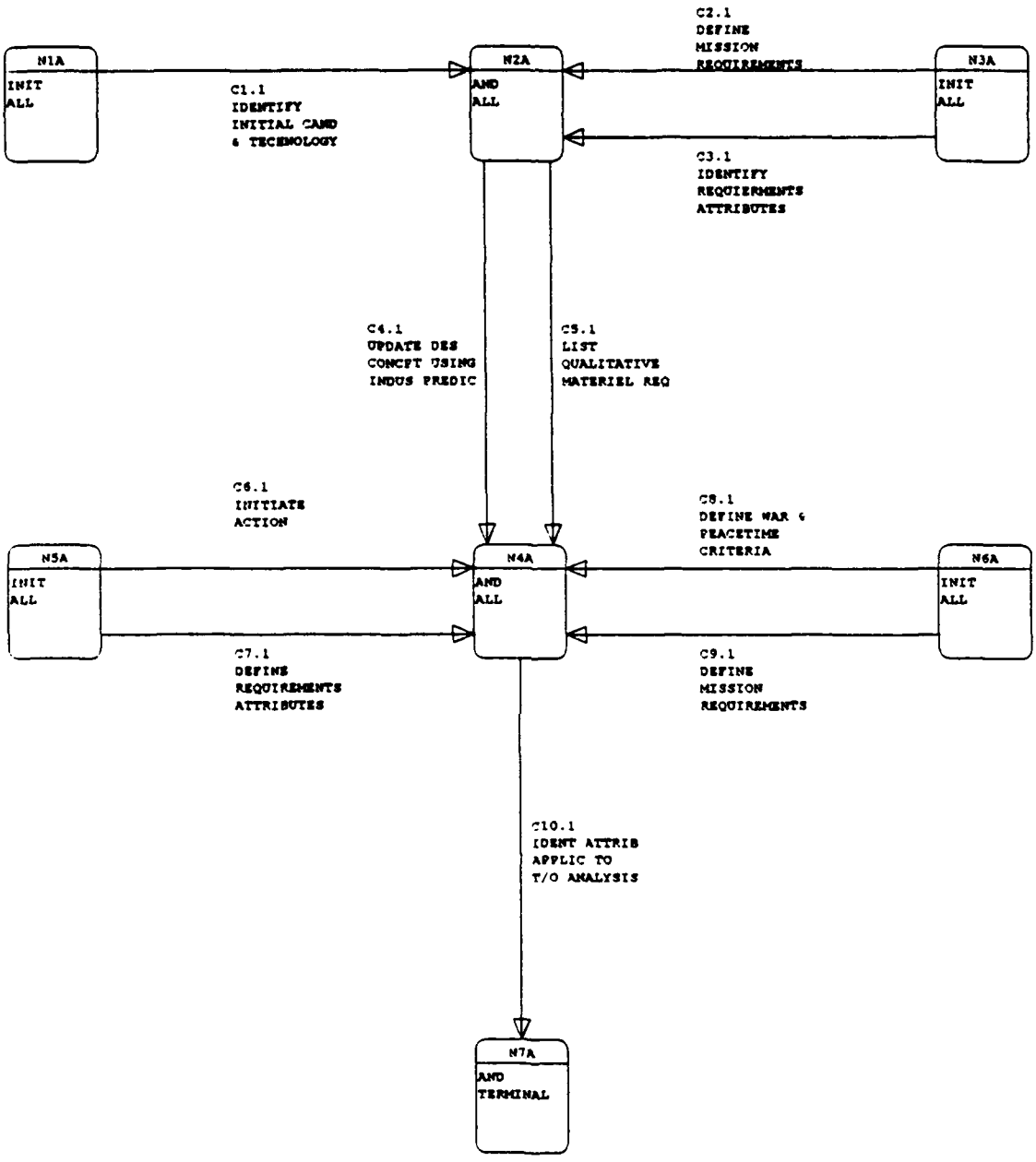

303.2.3.1A TRADEOFF ANALYSIS DAT
Created by: SID
Revised by: SID
Date changed: 30-MAR-90

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   1. 0016  10                  TRADE-OFF ANALYSIS DATA
                +         +         +         +         +         +         +         +
   2. C1.1     N1A       N2A        1.0 IDENTIFY INITIAL CANDIDATES & TECHNOLOGY
   3. C1.1     DTIME 1           2        10.0       20.0
   4. C1.1     DCOST 1           2        10.0      100.0
   5. C1.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
   6. C2.1     N3A       N2A        1.0 DEFINE MISSION REQUIREMENTS
   7. C2.1     DTIME 1           2        10.0       20.0
   8. C2.1     DCOST 1           2        10.0      100.0
   9. C2.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  10. C3.1     N3A       N2A        1.0 IDENTIFY REQUIREMENTS ATTRIBUTES
  11. C3.1     DTIME 1           2        10.0       20.0
  12. C3.1     DCOST 1           2        10.0      100.0
  13. C3.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  14. C4.1     N2A       N4A        1.0 UPDATE DESIGN CONCEPT USING INDUSTRY PREDICTIONS
  15. C4.1     DTIME 1           2        10.0       20.0
  16. C4.1     DCOST 1           2        10.0      100.0
  17. C4.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  18. C5.1     N2A       N4A        1.0 LIST QUALIITATIVE MATERIEL REQUIREMENTS
  19. C5.1     DTIME 1           2        10.0       20.0
  20. C5.1     DCOST 1           2        10.0      100.0
  21. C5.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  22. C6.1     N5A       N4A        1.0 INITIATE ACTION
  23. C6.1     DTIME 1           2        10.0       20.0
  24. C6.1     DCOST 1           2        10.0      100.0
  25. C6.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  26. C7.1     N5A       N4A        1.0 DEFINE REQUIREMENTS ATTRIBUTES
  27. C7.1     DTIME 1           2        10.0       20.0
  28. C7.1     DCOST 1           2        10.0      100.0
  29. C7.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  30. C8.1     N6A       N4A        1.0 DEFINE WARTIME & PEACETIME CRITERIA
  31. C8.1     DTIME 1           2        10.0       20.0
  32. C8.1     DCOST 1           2        10.0      100.0
  33. C8.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  34. C9.1     N6A       N4A        1.0 DEFINE MISSION REQUIREMENTS
  35. C9.1     DTIME 1           2        10.0       20.0
  36. C9.1     DCOST 1           2        10.0      100.0
  37. C9.1     DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  38. C10.1    N4A       N7A        1.0 IDENTIFY ATTRIBUTES APPLICABLE TO TRADE-OFF ANAL.
  39. C10.1    DTIME 1           2        10.0       20.0
  40. C10.1    DCOST 1           2        10.0      100.0
  41. C10.1    DPERF 1           2        10.0       50.0
                +         +         +         +         +         +         +         +
  42. ENDARC
                +         +         +         +         +         +         +         +
  43. N1A      1  2 0 0
                +         +         +         +         +         +         +         +
                1         2         3         4         5         6         7         8
```

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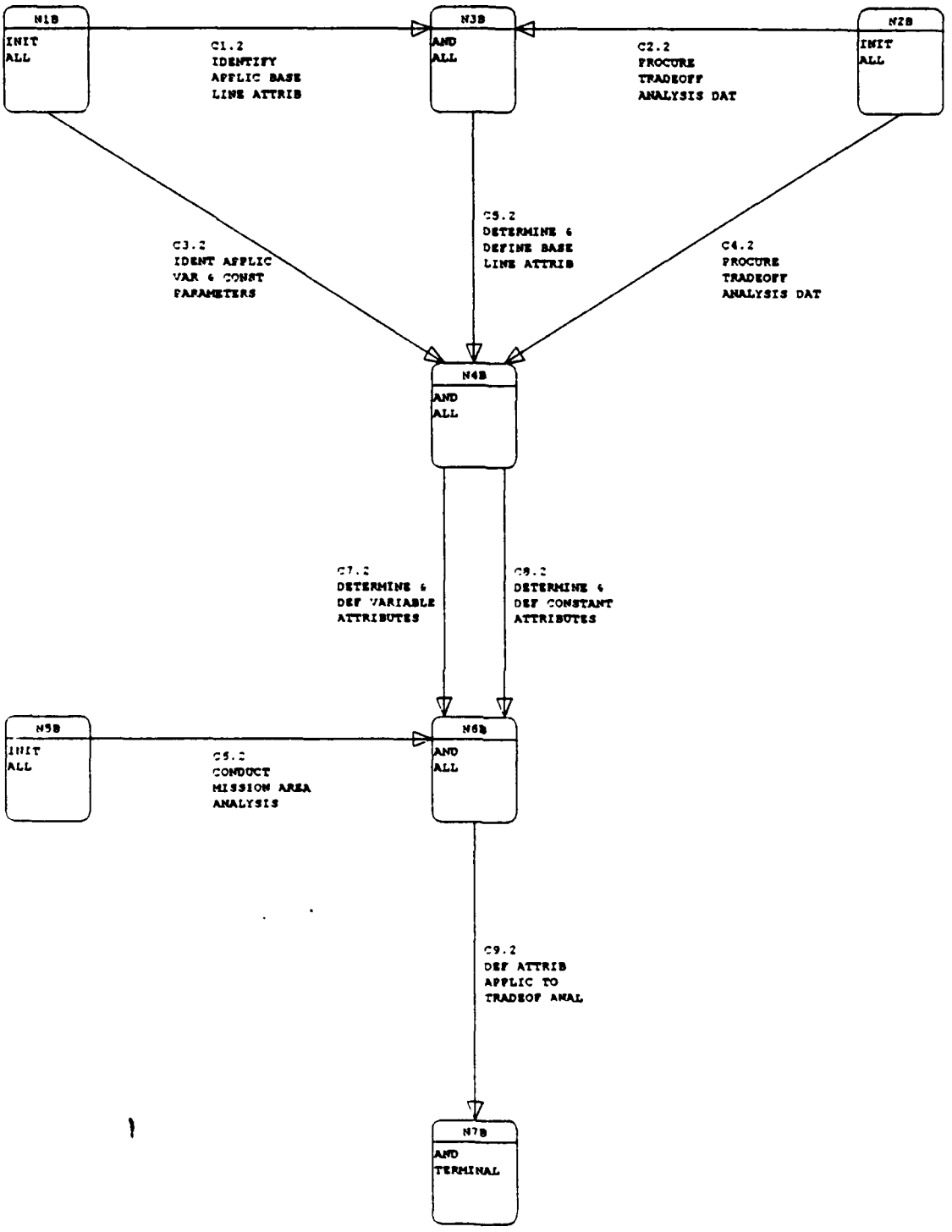
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
1          N E W   N E T W O R K                    PAGE  2
                  1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
44. N2A     2  2 0 0
                  +         +         +         +         +         +         +         +
45. N3A     1  2 0 0
                  +         +         +         +         +         +         +         +
46. N4A     2  2 0 0
                  +         +         +         +         +         +         +         +
47. N5A     1  2 0 0
                  +         +         +         +         +         +         +         +
48. N6A     1  2 0 0
                  +         +         +         +         +         +         +         +
49. N7A     2  1 0 0
                  +         +         +         +         +         +         +         +
50. ENDNODE
                  1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
```



303.2.3.2A VERT EST & DEF PARAM
Created by: CEAU
Revised by: SID
Date changed: 02-APR-90

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1          NEW  NETWORK                    PAGE  1
                1        2        3        4        5        6        7        8
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
    1. 0016  10                 ESTIMATION & DEFINITION PARAMETERS
                +        +        +        +        +        +        +        +
    2. C1.2     N1B      N3B       1.0 IDENTIFY APPLICABLE BASELINE ATTRIBUTES
    3. C1.2     DTIME 1          2       10.0      20.0
    4. C1.2     DCOST 1          2       10.0     100.0
    5. C1.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
    6. C2.2     N2B      N3B       1.0 PROCURE TRADEOFF ANALYSIS DATA
    7. C2.2     DTIME 1          2       10.0      20.0
    8. C2.2     DCOST 1          2       10.0     100.0
    9. C2.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   10. C3.2     N1B      N4B       1.0 IDENTIFY APPLICABLE VARIABLE & CONSTANT PARAMETERS
   11. C3.2     DTIME 1          2       10.0      20.0
   12. C3.2     DCOST 1          2       10.0     100.0
   13. C3.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   14. C4.2     N2B      N4B       1.0 PROCURE TRADEOFF ANALYSIS DATA
   15. C4.2     DTIME 1          2       10.0      20.0
   16. C4.2     DCOST 1          2       10.0     100.0
   17. C4.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   18. C5.2     N3B      N4B       1.0 DETERMINE AND DEFINE BASELINE ATTRIBUTES
   19. C5.2     DTIME 1          2       10.0      20.0
   20. C5.2     DCOST 1          2       10.0     100.0
   21. C5.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   22. C6.2     N5B      N6B       1.0 CONDUCT MISSION AREA ANALYSIS
   23. C6.2     DTIME 1          2       10.0      20.0
   24. C6.2     DCOST 1          2       10.0     100.0
   25. C6.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   26. C7.2     N4B      N6B       1.0 DETERMINE AND DEFINE VARIABLE ATTRIBUTES
   27. C7.2     DTIME 1          2       10.0      20.0
   28. C7.2     DCOST 1          2       10.0     100.0
   29. C7.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   30. C8.2     N4B      N6B       1.0 DETERMINE AND DEFINE CONSTANT ATTRIBUTES
   31. C8.2     DTIME 1          2       10.0      20.0
   32. C8.2     DCOST 1          2       10.0     100.0
   33. C8.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   34. C9.2     N6B      N7B       1.0 DEFINE ATTRIBUTES APPLICABLE TO TRADE-OFF ANALYSIS
   35. C9.2     DTIME 1          2       10.0      20.0
   36. C9.2     DCOST 1          2       10.0     100.0
   37. C9.2     DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   38. ENDARC
                +        +        +        +        +        +        +        +
   39. N1B      1  2 0 0
                +        +        +        +        +        +        +        +
   40. N3B      2  2 0 0
                +        +        +        +        +        +        +        +
   41. N2B      1  2 0 0
                +        +        +        +        +        +        +        +
   42. N4B      2  2 0 0
                +        +        +        +        +        +        +        +
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          1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
1       N E W   N E T W O R K                PAGE  2
          1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
42. N5B   1  2 0 0
          +         +         +         +         +         +         +         +
44. N6B   2  2 0 0
          +         +         +         +         +         +         +         +
45. N7B   2  1 0 0
          +         +         +         +         +         +         +         +
46. ENDNODE
          1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
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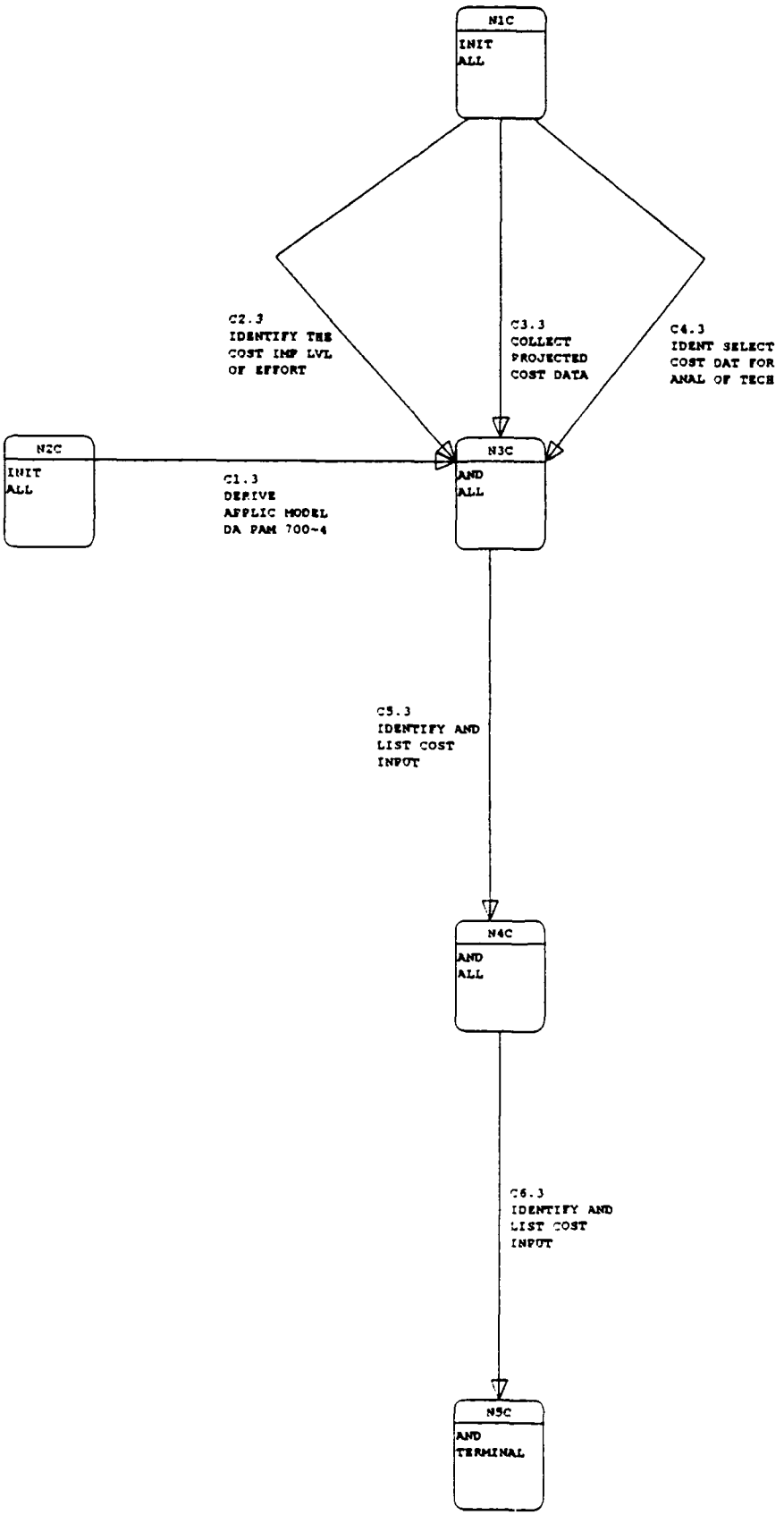
N1C
INIT
ALL
C2.3
IDENTIFY THE
COST IMP LVL
OF EFFORT
C3.3
COLLECT
PROJECTED
COST DATA
C4.3
IDENT SELECT
COST DAT FOR
ANAL OF TECH
N2C
INIT
ALL
C1.3
DERIVE
APPLIC MODEL
DA PAM 700-4
N3C
AND
ALL
C5.3
IDENTIFY AND
LIST COST
INPUT
N4C
AND
ALL
C6.3
IDENTIFY AND
LIST COST
INPUT
N5C
AND
TERMINAL
303.2.3.4A VERT COST FORMULA
Created by: CHAO
Revised by: SID
Date changed: 30-MAR-90

```
1        N E W   N E T W O R K                PAGE  1
               1         2         3         4         5         6         7         8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
   1. 0016  10                  COST FORMULA
               +         +         +         +         +         +         +         +
   2. C1.3     N2C       N3C        1.0 DERIVE APPLICABLE MODEL AMC P-700-4
   3. C1.3     DTIME 1           2       10.0       20.0
   4. C1.3     DCOST 1           2       10.0      100.0
   5. C1.3     DPERF 1           2       10.0       50.0
               +         +         +         +         +         +         +         +
   6. C2.3     N1C       N3C        1.0 IDENTIFY THE COST IMPACT LEVEL OF EFFORT
   7. C2.3     DTIME 1           2       10.0       20.0
   8. C2.3     DCOST 1           2       10.0      100.0
   9. C2.3     DPERF 1           2       10.0       50.0
               +         +         +         +         +         +         +         +
  10. C3.3     N1C       N3C        1.0 COLLECT PROJECTED COST DATA
  11. C3.3     DTIME 1           2       10.0       20.0
  12. C3.3     DCOST 1           2       10.0      100.0
  13. C3.3     DPERF 1           2       10.0       50.0
               +         +         +         +         +         +         +         +
  14. C4.3     N1C       N3C        1.0 IDENT. SLCTIVE COST DATA FOR ANAL. OF TECH. REQS.
  15. C4.3     DTIME 1           2        10.       20.0
  16. C4.3     DCOST 1           2       10.0      100.0
  17. C4.3     DPERF 1           2       10.0       50.0
               +         +         +         +         +         +         +         +
  18. C5.3     N3C       N4C        1.0 IDENTIFY AND LIST COST INPUT
  19. C5.3     DTIME 1           2       10.0       20.0
  20. C5.3     DCOST 1           2       10.0      100.0
  21. C5.3     DPERF 1           2       10.0       50.0
               +         +         +         +         +         +         +         +
  22. C6.3     N4C       N5C        1.0 IDENTIFY AND LIST COST INPUT
  23. C6.3     DTIME 1           2       10.0       20.0
  24. C6.3     DCOST 1           2       10.0      100.0
  25. C6.3     DPERF 1           2       10.0       50.0
               +         +         +         +         +         +         +         +
  26. ENDARC
               +         +         +         +         +         +         +         +
  27. N2C      1  2 0 0
               +         +         +         +         +         +         +         +
  28. N3C      2  2 0 0
               +         +         +         +         +         +         +         +
  29. N1C      1  2 0 0
               +         +         +         +         +         +         +         +
  30. N4C      2  2 0 0
               +         +         +         +         +         +         +         +
  31. N5C      2  1 0 0
               +         +         +         +         +         +         +         +
  32. ENDNODE
               1         2         3         4         5         6         7         8
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
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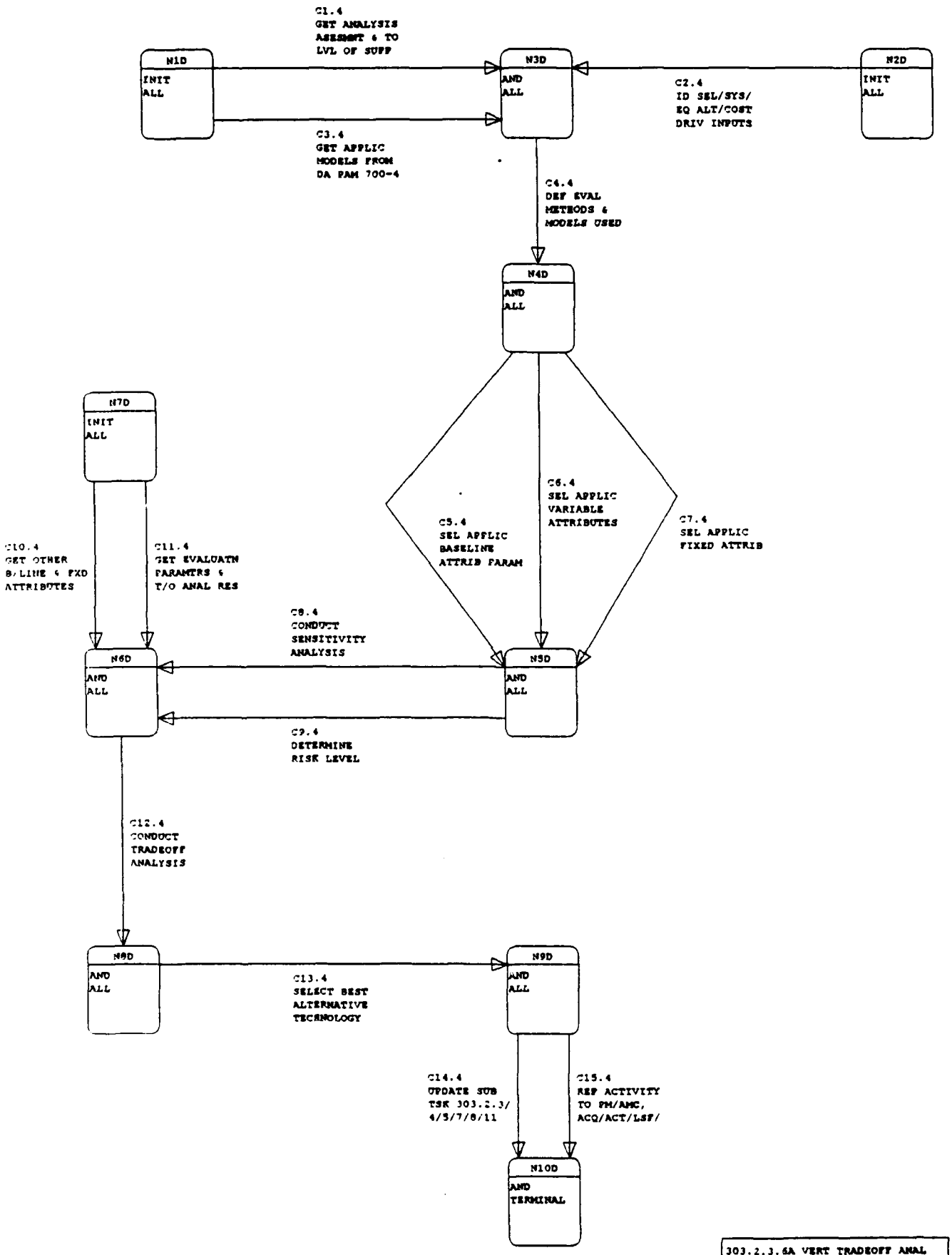
C1.4
GET ANALYSIS
ASSESMT & TO
LVL OF SUFF
N1D
INIT
ALL
N3D
AND
ALL
N2D
INIT
ALL
C2.4
ID SEL/SYS/
EQ ALT/COST
DRIV INPUTS
C3.4
GET APPLIC
MODELS FROM
DA PAM 700-4
C4.4
DEF EVAL
METHODS &
MODELS USED
N4D
AND
ALL
N7D
INIT
ALL
C5.4
SEL APPLIC
BASELINE
ATTRIB PARAM
C6.4
SEL APPLIC
VARIABLE
ATTRIBUTES
C7.4
SEL APPLIC
FIXED ATTRIB
C10.4
GET OTHER
B/LINE & FXD
ATTRIBUTES
C11.4
GET EVALUATN
PARAMTRS &
T/O ANAL RES
C8.4
CONDUCT
SENSITIVITY
ANALYSIS
N6D
AND
ALL
N5D
AND
ALL
C9.4
DETERMINE
RISK LEVEL
C12.4
CONDUCT
TRADEOFF
ANALYSIS
N8D
AND
ALL
N9D
AND
ALL
C13.4
SELECT BEST
ALTERNATIVE
TECHNOLOGY
C14.4
UPDATE SUB
TSK 303.2.3/
4/5/7/8/11
C15.4
REP ACTIVITY
TO PM/AMC,
ACQ/ACT/LSF/
N10D
AND
TERMINAL
303.2.3.6A VERT TRADEOFF ANAL
Created by: CHAU
Revised by: SID
Date changed: 02-APR-90

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1          NEW  NETWORK                PAGE  1
                1        2        3        4        5        6        7        8
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
    1. 0016  10                TRADE-OFF ANALYSIS
                +        +        +        +        +        +        +        +
    2. C1.4    N1D      N3D       1.0 GET ANALYSIS ASSESSMENT AND TO LEVEL OF SUPPORT
    3. C1.4    DTIME 1          2       10.0      20.0
    4. C1.4    DCOST 1          2       10.0     100.0
    5. C1.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
    6. C2.4    N2D      N3D       1.0 IDENT. SELECTED EQ/SYS ALT. COST DRIVER INPUTS
    7. C2.4    DTIME 1          2       10.0      20.0
    8. C2.4    DCOST 1          2       10.0     100.0
    9. C2.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   10. C3.4    N1D      N3D       1.0 GET APPLICABLE MODELS FROM DA PAM 700-4
   11. C3.4    DTIME 1          2       10.0      20.0
   12. C3.4    DCOST 1          2       10.0     100.0
   13. C3.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   14. C4.4    N3D      N4D       1.0 DEFINE EVALUATION METHODS & MODELS USED
   15. C4.4    DTIME 1          2       10.0      20.0
   16. C4.4    DCOST 1          2       10.0     100.0
   17. C4.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   18. C5.4    N4D      N5D       1.0 SELECT APPLICABLE BASELINE ATTRIBUTE PARAMETERS
   19. C5.4    DTIME 1          2       10.0      20.0
   20. C5.4    DCOST 1          2       10.0     100.0
   21. C5.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   22. C6.4    N4D      N5D       1.0 SELECT APPLICABLE VARIABLE ATTRIBUTES
   23. C6.4    DTIME 1          2       10.0      20.0
   24. C6.4    DCOST 1          2       10.0     100.0
   25. C6.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   26. C7.4    N4D      N5D       1.0 SELECT APPLICABLE FIXED ATTRIBUTES
   27. C7.4    DTIME 1          2       10.0      20.0
   28. C7.4    DCOST 1          2       10.0     100.0
   29. C7.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   30. C8.4    N5D      N6D       1.0 CONDUCT SENSITIVITY ANALYSIS
   31. C8.4    DTIME 1          2       10.0      20.0
   32. C8.4    DCOST 1          2       10.0     100.0
   33. C8.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   34. C9.4    N5D      N6D       1.0 DETERMINE RISK LEVEL
   35. C9.4    DTIME 1          2       10.0      20.0
   36. C9.4    DCOST 1          2       10.0     100.0
   37. C9.4    DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   38. C10.4   N7D      N6D       1.0 GET OTHER KNOWN BASELINE AND FIXED ATTRIBUTES
   39. C10.4   DTIME 1          2       10.0      20.0
   40. C10.4   DCOST 1          2       10.0     100.0
   41. C10.4   DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
   42. C11.4   N7D      N6D       1.0 GET EVALUATION PARAMETERS & TRADEOFF ANAL RESULTS
   43. C11.4   DTIME 1          2       10.0      20.0
   44. C11.4   DCOST 1          2       10.0     100.0
   45. C11.4   DPERF 1          2       10.0      50.0
                +        +        +        +        +        +        +        +
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                1         2         3         4         5         6         7         8
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
1        N E W    N E T W O R K                    PAGE   2
                1         2         3         4         5         6         7         8
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
   46. C12.4   N6D      N8D       1.0 CONDUCT TRADEOFF ANALYSIS
   47. C12.4   DTIME 1          2       10.0      20.0
   48. C12.4   DCOST 1          2       10.0     100.0
   49. C12.4   DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
   50. C13.4   N8D      N9D       1.0 SELECT BEST ALTERNATIVE TECHNOLOGY
   51. C13.4   DTIME 1          2       10.0      20.0
   52. C13.4   DCOST 1          2       10.0     100.0
   53. C13.4   DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
   54. C14.4   N9D      N10D      1.0 UPDATE SUBTASKS 303.2.3/4/5/7/8/11/12
   55. C14.4   DTIME 1          2       10.0      20.0
   56. C14.4   DCOST 1          2       10.0     100.0
   57. C14.4   DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
   58. C15.4   N9D      N10D      1.0 REP ACTIVITY TO PM/AMC TRADOC, UPDATE APPLIC FILES
   59. C15.4   DTIME 1          2       10.0      20.0
   60. C15.4   DCOST 1          2       10.0     100.0
   61. C15.4   DPERF 1          2       10.0      50.0
                +         +         +         +         +         +         +         +
   62. ENDARC
                +         +         +         +         +         +         +         +
   63. N1D     1  2 0 0
                +         +         +         +         +         +         +         +
   64. N3D     2  2 0 0
                +         +         +         +         +         +         +         +
   65. N2D     1  2 0 0
                +         +         +         +         +         +         +         +
   66. N4D     2  2 0 0
                +         +         +         +         +         +         +         +
   67. N5D     2  2 0 0
                +         +         +         +         +         +         +         +
   68. N6D     2  2 0 0
                +         +         +         +         +         +         +         +
   69. N7D     1  2 0 0
                +         +         +         +         +         +         +         +
   70. N8D     2  2 0 0
                +         +         +         +         +         +         +         +
   71. N9D     2  2 0 0
                +         +         +         +         +         +         +         +
   72. N10D    2  1 0 0
                +         +         +         +         +         +         +         +
   73. ENDNODE
                1         2         3         4         5         6         7         8
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
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ANNEX E

STRUCTURED SYSTEMS ANALYSIS
Fundamentals

NOTE: Our presentation of Structured Analysis Fundamentals with the associated figures is reproduced verbatim in each report.

ANNEX E
STRUCTURED SYSTEMS ANALYSIS

Fundamentals

Structured Systems Analysis (SSA) has recently become an industry standard for generating Data Flow Diagrams (replacing "logic diagrams" or "flow charts") to aid in coordinating the functions to be performed by a computer program and its associated Inputs/Outputs (I/O). During the SSA, each set of "flow charts" can be checked by the potential user to assure that there is complete agreement on what is to be done by the program, and how it is to be accomplished. It also provides considerable flexibility for updating or changing the program.

Six basic elements (see Figure 1) are used in SSA:

1. Process (PRC)
2. Data Flow (DAF)
3. Data Store (DAS)
4. External Entity (EXT)
5. Data Flow Diagram (DFD)
6. Data Dictionary (DCT)

PROCESS (Represented by a Circle):

A function or operation to be performed which can be explained by a set of instructions representing a single task, e.g., "calculate interest on a loan", "prepare a draft report". If the Process description is too complex to describe in a few steps, it may be necessary to develop a lower level description (see below).

DATA FLOW (Lines interconnecting Processes or I/Os):

Each function or Process cannot be a stand-alone in a complex network. To have any meaning in a program, each process must be initiated by a previous action and/or provided information on which to act. Furthermore, a Process must result in an output which is the input to the next logical Process... These inputs, outputs, or initiating actions are identified as Data Flows, and are represented by the Data Flow lines indicating its point of origin and the process to which it provides data.

DATA STORE (Represented by two parallel lines):

Although some Processes generate data used as input to a succeeding Process, there is often a need to "gather or collect" information from files in which it is stored. This information may come from an external source (such as a MIL-STD, Army regulation, historical experience files, etc.), or an internal source or file in which data is temporarily stored for use by succeeding processes. These Data Stores can be visualized as a "file cabinet", in which the data are stored for later retrieval).

EXTERNAL ENTITY (Represented by a Rectangle):

Each program or logical process must have an initiating action, a "point" of disposition of the results, and possible input guidance or instructions. Each of these have authorities, functions, or applications which are independent of the program Process (although required by the program Process). Thus, these activities, agencies, or facilities are considered "External Entities" to the program.

DATA FLOW DIAGRAM:

The general arrangement of the above can be readily seen. First, the circle or Process describes what has to be done; the interconnecting lines represent the Data Flows, together with the specific description of all I/Os. The Data Stores identify the source and/or file designation of a data base, and the External Entities represent those activities remote from the Process, which are the source of guidance or the recipients of the program. This combination of Processes, Data Flows, Data Stores, and External Entities constitutes a "Data Flow Diagram". The unique feature of the Data Flow Diagram (DFD) is that each process can be considered independently, permitting a change to be made in one Process without a major change in the overall program.

DATA DICTIONARY:

The Data Dictionary consists of a complete description of each of the basic elements. For the Process, it contains a step-by-step description of what has to be performed. The description of the Data Flow identifies the nomenclature of the data, a detailed description of its content, and its source. The Data Stores and External Entities are described, including possible location.

The Data Dictionary (a living document) begins with a description of the first Process and is continually built-up as the Data Flow Diagrams are expanded, detailed, and eventually completed.

APPROACH TO PERFORMING STRUCTURED SYSTEM ANALYSIS:

The best approach to Structured Systems Analysis is to assume that the program consists of a series of processes, each of which are to be assigned to an inexperienced analyst. Each analyst is to be walked through the assigned process of the Program, explaining step-by-step functions have to be performed or what actions have to be taken to accomplish the process. The analyst is also informed where the information is coming from (input Data Flow), what is to be generated by each process (output Data Flow), where the data base may to be found (Data Stores), and who to contact for guidance (External Entities).

The best way to initiate a SSA is to set down the point of origin of a program, its final goal(s), and the intermediate functions or actions needed to get from beginning to goal. Each step should be considered as a Process - some may be sequential and others parallel. Then, the steps needed to accomplish the Process should be described. If the description is complex and needs intermediate steps, the Process is then a candidate for an "explosion". That is, the top (or upper) level Process is considered as a "project" and its own Data Flow Diagram is prepared.

When writing the step-by-step procedures in the Process, certain elements of data (or information) must be made available for the procedure. Each element of data is considered as an input Data Flow, which is identified and described. The product (or result) of a Process is an output Data Flow element.

Each Data Flow to the Process must originate from:

1. an earlier Process
2. a Data Store (or file)
3. an External Entity.

These sources are also identified, described and put into the Data Dictionary. As soon as the last portion of the Data Flow Diagram has been described, the SSA is complete.

The structured Analysis phase is followed by Structured Design, then by programming and finally software test and validation. The organization of Structured Analysis and its relationship to Structured System Design is shown on below on Figure 2.

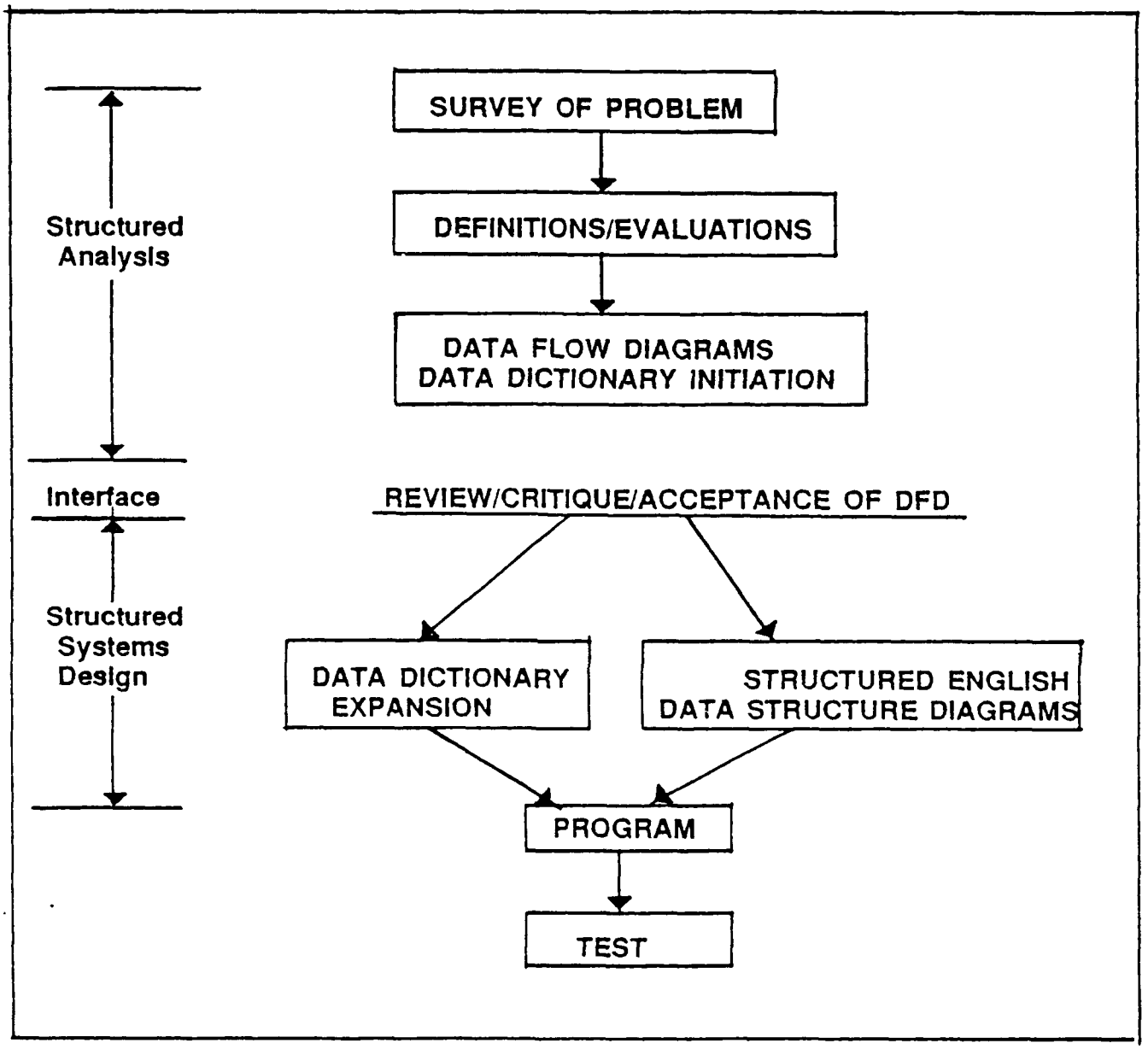

Figure 1. Structured Analysis & Structured Systems Design Organization

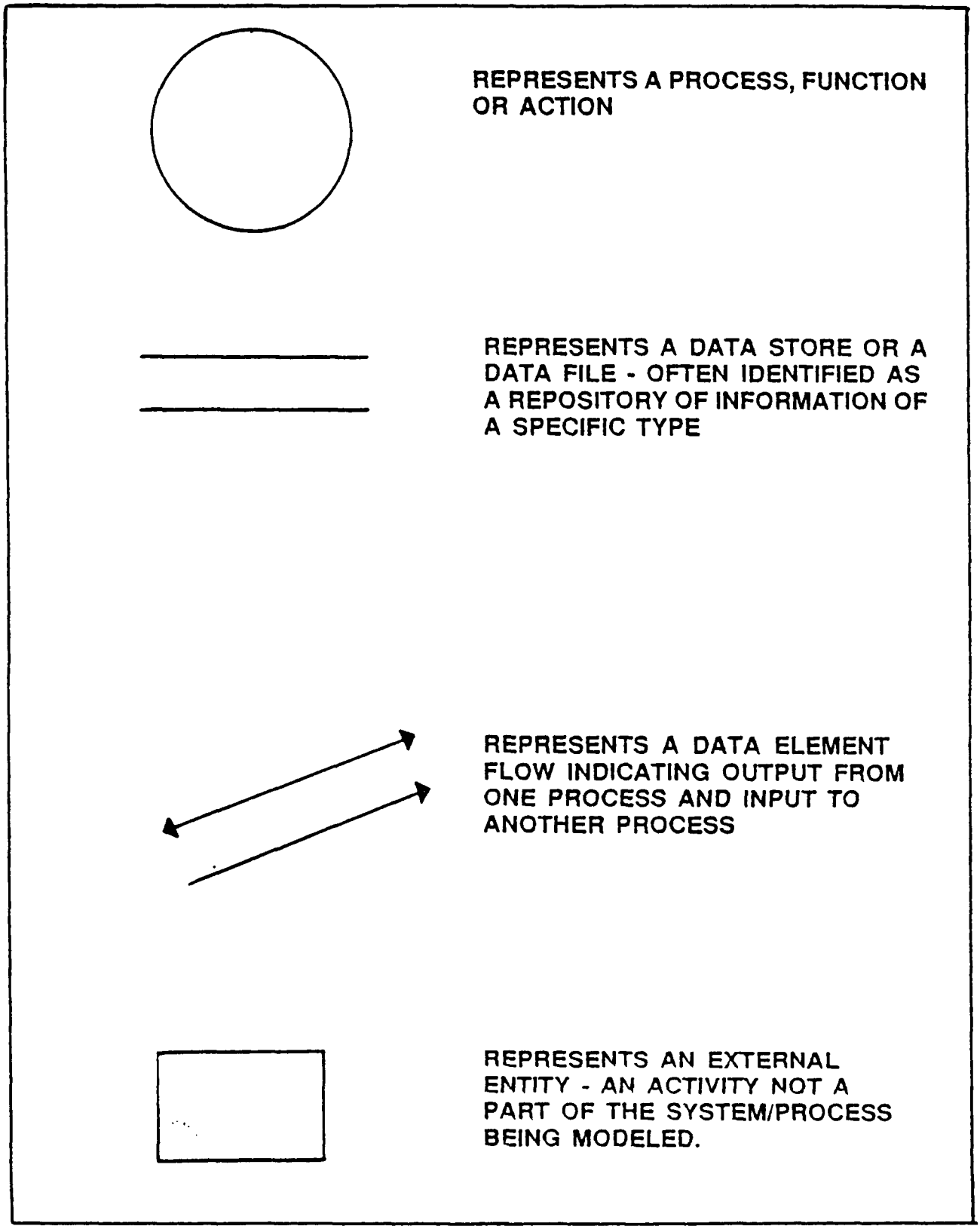

Figure 2. Standard DFD Symbol Definitions